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ELECTRICAL WORLD AND ENGINEER.

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CONTENTS.

Editorial	499
Chamber of Delegates, International Electrical Congress, St. Louis, 1904	502
Final General Meeting of the International Electrical Congress	502
Courtesies to the Congress at St. Louis	502
The Northern California Power Company's Systems—III	503
Testing of Large Capacity Induction Wattmeters. By E. W. Gough	506
Power Transmission Before the Electrical Congress	507
The Phipps Power Building, Pittsburg	510
German Electrical Exhibits at the World's Fair—IV. By Franz Welz	512
A Trolley Parallel for Steam Railroad	514
Suction Gas Producers. By Oskar Nagel	515
Anniversary of Electric Traction in Germany	515
Internal Combustion Engines at the St. Louis Exposition	516
The Carbon Brush. By Howard S. Knowlton	518
Northwestern Electrical Association at St. Louis	518
Discussions on General Applications of Electricity by the International Electrical Congress	519
Annual Convention of the National Electrical Contractors' Association	523
Annual Convention of the International Association of Municipal Electricians	523
New England Cotton Manufacturers on Electric Power	523
Electrical Theory at the International Electrical Congress	524
Electrochemistry at the International Electrical Congress	525
Electric Light and Distribution Before the International Electrical Congress	527
Pres. Arnold on the Application of Electricity to Railroads	530
The Congress Circular Tour	530
Social Events of the Congress Week	532
Chamber of Delegates, International Electrical Congress	532
Current News and Notes	534
LETTERS TO THE EDITORS:	
"Electrigizing" a Machinery Plant. By Robert W. Mason	534
The Regulation of Wiring. By Alfred Pekingston	534
Digest of Current Electrical Literature	535
New Auto Telegraph Car	538
Joint for Stranded Wires	539
An Aluminum Exhibit at St. Louis	539
The Chicago Fuse Wire & Mfg. Co. at the Fair	539
Heater for Small Quantities of Liquid	540
Features of the Contractors' Convention at St. Louis	540
News of the Week	541

OUR CONGRESS REPORT.

In our issue of last week abstracts were printed of a large number of the papers presented before the International Electrical Congress at St. Louis, those read on Monday and Tuesday being accompanied by a telegraphic report of the ensuing discussions. In this issue is given a report in extenso of the proceedings of all sessions of four of the eight Congress sections, namely, those representing general theory, general applications, electrochemistry, electric power transmission and electric light and distribution. Owing to limitations of space, similar reports of the proceedings of the remaining sections, as well as the report of the joint meeting of the British Association of Electrical Engineers, the American Institute of Electrical Engineers, and Section F, are reserved for the following issue. As in the case of the Chicago Exposition of 1893, this journal had present at each meeting of every section to report the proceedings, a specialist in the branches considered, and we believe the reader will find that these gentlemen have admirably performed their task.

WORLD'S FAIRS.

In a speech welcoming to St. Louis the International Electrical Congress, President Francis, of the World's Fair, predicted that international electrical expositions would be less frequent in the future than in the past, and pointed out that the deficiency could with great profit be made up by the holding of international expositions devoted to a single art. From a technical and industrial standpoint this latter consummation is devoutly to be wished. The Universal World's Fair has come to be largely a popular show in which the great attractions are the beautiful buildings with their surroundings, and the Coney Island amusement feature, which has grown from the modest Rue de Caire of the Paris Exposition of 1889 to the "Pike" at St. Louis, which, if we except the Philippine exhibit, overshadows all else there. The electrical exposition at Paris in 1881 and the recent machinery exposition at Dusseldorf have certainly demonstrated that a great art on display can in itself furnish an attraction sufficient to insure financial success, while from the technical, industrial and commercial standpoints the advantage should be enormously in favor of the special show.

It is true that an exposition devoted to a single art would not have the popular interest of the universal exposition and therefore the attendance would be relatively limited. Assuming that the visitors would be sufficient in number to defray expenses—which is entirely probable—the lesser attendance would be an overwhelming advantage in that it would not give occasion for the organized extortion practiced on visitors which has been so unhappily characteristic of World's Fairs, and particularly of those held in this country, with its baleful effect abroad on the reputation of our people through the impressions carried home by foreign visitors. Indeed, we believe that very few Americans who have visited our World's Fairs will ever again have a kindly feeling for the communities in which they have been subjected to gross impositions, and their dislike will be apt to be imparted to widening circles upon their return home. But the deplorable consequences of the cupidity of those who in World's Fair cities seize the opportunity "to make hay while the sun shines" regardless of even elementary ideas of decency, is the effect on foreign visitors, whose stay in the country is in most cases not sufficient for them to be subjected to counteracting influences through contact with the American people under normal conditions. Thus from the sociological side the World's Fair with its immense attend-

ance and concomitant organized prey on the visitors to its seat, can well be spared. We have occasion to see many foreign visitors to these shores, and in normal years upon the eve of their return home it is most gratifying to hear their sincere expressions of admiration for our country and our people; but we regret to say that during a World's Fair year there is an ominous silence on these points.

ELECTRICAL INSPECTION.

Elsewhere we print a letter inveighing in no measured terms against a proposition made recently by a writer in these columns advocating a combination of fire underwriters, electric light companies and electrical manufacturers, with a view to improving the character of the interior electrical installations. Without going into the details of the suggestion, we must confess a sympathy with our correspondent on the general question of combinations of the kind suggested, in which self-interest is the underlying principle and not primarily the interests of the public or the owners of installations. The only public reason that can be offered to justify the imposition of rules as to how one may install electrical circuits in his property, is that unless outside supervision is exercised the safety of the public is apt to be endangered through fire hazard. As all property is now insured, the underwriters are the body having the most direct interest in seeing that the installation is properly made, both with respect to material and workmanship, and thus they incidentally perform an important public service and one which appears to be amply sufficient to meet the requirements in this particular case. That this service is apt to be as well served through this channel as all the conditions will permit follows from the reason that a money interest is at stake, the inspection is organized with a view to serving in the highest degree this selfish interest, and delinquency on the part of the inspectors exposes them to immediate discharge. So far as the interior electrical installation work is concerned it appears to us that even municipal inspection in addition to underwriters' inspection is superfluous, and we can see absolutely no reason why manufacturers should have any voice in the matter. Aside from the question of public safety, there is no more reason why a man who puts electric light or power in his premises should have his interests paternally guarded than if he were making expenditures for household furnishings or purchasing a horse. If he is imposed upon by dealers or contractors, that is his personal misfortune. The underwriters' inspection will incidentally safeguard the public, and the electric light station is amply able to look out for its own interests.

ADMINISTRATIVE SIDE OF THE CONGRESS.

The International Electrical Congress at St. Louis, 1904, can without hesitation be pronounced the most brilliant by far of the five electrical congresses thus far convened, if it be judged by successful organization and conduct, by attendance, by the character of papers presented and by the sustained interest shown in the proceedings. Some of the steps that have led up to this happy culmination may not at the present moment be without interest. The first action toward organization was taken in June, 1904, at which time it was proposed to hold the Congress under the auspices of the various national electrical bodies. Later it was found, however, that, owing to contending interests, this plan was not practicable, and in September of the same year the organization was completed on an entirely independent basis. The committee of organization then immediately proceeded to solicit adhesions to the congress, which work was pursued in a most energetic manner, for it was considered extremely desirable to secure, in the form of membership fees, funds sufficient to pay all expenses of the Congress, and thus obviate recourse to the corporations and the marked individuals generously inclined, who so frequently are called upon to foot the bills for electrical functions. This hope, we are glad to say, has been fully realized. Through the exercise of the strictest economy and great care in making contracts, the funds on hand are sufficient to pay all expenses incident to the preliminary work and the conduct of the Congress, including the necessarily costly stenographic report, and the cost of printing and delivery to each member a copy of the Transactions, which publication will comprise three bulky octavo volumes. At the beginning of the present year lists of the authors to be invited to read papers were prepared, a subject being suggested for each author. The list was made as inclusive as could be of the authorities of the world in electrical science and engineering, and it is gratifying to know that favorable responses were received from the majority of those to whom invitations to contribute papers were addressed. It was hoped to have at St. Louis advance printed copies of all of the papers to be presented, but owing to the delay of authors in sending in manuscript, this was impossible. However, of the 160 papers presented almost 100 were distributed in printed form at the sessions, though all but two of these were in manuscript as late as the beginning of August.

THE PROPOSED INTERNATIONAL ELECTRICAL COMMISSION.

In one respect only will the Congress of 1904 figure in history with less eclat than the three preceding successful Congresses—those of 1881, 1893 and 1900—namely, that it will not be connected by name with any action by its Chamber of Official Delegates with respect to units or standards. On the other hand, the St. Louis Chamber of Delegates has rendered a very great service by putting forth, with every chance of adoption, a practicable plan for future international electrical scientific coöperation, at a moment when such coöperation through international electrical congresses seemed to have reached its close. Although Great Britain and France at the last moment gave official recognition to the Chamber of Delegates of the Congress, and Germany accorded a sparing recognition through withholding from its single delegate authority to vote on questions of units and standards, it has for some time been clearly evident that the continuance of consideration at World's Fair congresses of matters of a kind that have in the past been brought before and decided by Chambers of Delegates forming part of such congresses, had shown itself far from desirable for several reasons. In the first place, owing to the fortuitous occurrence of World's Fairs at indefinite intervals, and the uncertainty until a late date that the programme would include an international congress, or whether such a congress, if included, could be taken seriously, there has naturally been little time for formulation of propositions to be brought before a congress and for the wide preliminary discussion that such propositions should receive. In the second place, with the exception of the congresses of 1881 and 1893, it cannot be denied that their membership has not been representative to the highest degree of the scientific standing of some of the countries sending delegates. Indeed, perhaps the majority of the delegates at congresses have been merely those who, intending to visit the Fair, solicited and received appointment as delegates with little or no reference to their qualifications for the duties involved.

The Chamber of Delegates at St. Louis very wisely did not handicap its recommendations with details concerning the organization and scope of the international commission proposed, which matter will doubtless be thoroughly considered at the meeting of the first commission. In view of this important work to be accomplished, it is extremely desirable that the selection of the first delegates should be most carefully made by the several governments. If the commission is composed entirely of officials representing the scientific departments of the several governments, there is a probability that its usefulness to science and engineering will be very restricted, for any action taken by such a body would be apt not to go much outside of bureaucratic lines. It would, therefore, seem most wise if the delegation should consist of at least two members, only

one of whom would be a government official. As to the matters to be considered by such a commission, it seems desirable that considerable initiation should lie with the electrical scientific and engineering authorities and associations of the world. Such initiative could be guarded by giving the commission jurisdiction to pronounce upon the competency of the authority or body offering a proposition, and upon the relevancy of the proposition. So far as action by such a body is concerned, a recommendation by it not at all binding in any manner upon the governments represented would have great weight in scientific and electrical circles, and indeed, in most all cases, a recommendation would have the practical effect of definite official action. As to matters requiring action of a more formal kind, it might be well in order to guard as fully as possible against error that a commission should only put forth recommendations concerning matters initially brought before it and be empowered to take final action committing their governments only on recommendations put forth by preceding commissions. If the interval between the meeting of such commissions were, say, five years, the discussion during that period of a recommendation would, without doubt, in most cases determine whether it should receive formal governmental sanction. The main point, however, is that such a tribunal as that proposed should be as far as possible an open court for the consideration of matters relating to electrical units, standards, notation, nomenclature and other matters concerning which it is desirable to have international accord, and not merely a meeting of government functionaries for the decision of questions arising in bureaucratic routine.

THE INTERNATIONAL ELECTRICAL CONGRESS OF ST. LOUIS.

Now that the International Electrical Congress of St. Louis, 1904—the fifth of such bodies—has passed and gone into history, it is of interest to review its immediate results, as well as those which are likely later to ensue. About 160 papers were read and discussed, many of which possess great technical value. The number of persons attending exceeded 700, of which some 150 were from countries outside of the United States. Delegates were also present from nearly all of the electrotechnical societies of Europe and America. Since the task of reading and discussing these papers occupied the morning sessions of four days in the Congress week, it is evident that even with eight sections working simultaneously, and over 100 of the papers distributed in printed form, the discussions were necessarily condensed and restricted in extent. The average number of papers presented during each session of four hours was approximately five for each section, affording, therefore, on the whole, some fifty minutes as the mean time allotted to each paper. The proceedings of the Congress so far as concerns the reading and discussion of papers, differed only from the annual convention of a technical society, such as the American Institute of Electrical Engineers, in the fact that the papers were discussed simultaneously in eight groups and halls side by side, and that all of the papers were specially invited from authors in many countries, instead of being volunteered from authors in one and the same country. The Transactions of the Congress, when printed, may be expected to resemble those of a national technical society, temporarily placed upon a cosmopolitan basis, but published in the English language. A number of papers have had, however, to be translated for that purpose, since they were presented in French, German, Italian or Spanish.

As regards the action of the Chamber of Delegates, this was kept as at Chicago, entirely separate from the main body of the Congress, both in hours and place of meeting. In this Chamber, in addition to the United States, eleven countries were represented by one or more official delegates. The resolutions of the Chamber are printed on another page of this issue. It will be seen from these resolutions that the Chamber took no immediate action upon any of the questions brought before it for consideration, but that a unanimous vote was registered for the appointment of an international governmental commission to deal with questions relating to electromagnetic units. Moreover, a similar resolution was reached that the various technical societies of the world should appoint an international commission to deal with standardizing the nomenclature and ratings of dynamo-electric apparatus and machinery. If the international governmental commission, thus recommended by the Chamber of Delegates, is successfully convoked, it ought to be able to effect a complete unification of international electrical standards all over the world. We might then look for a uniform volt, ohm and ampere, in all the principal electrical laboratories of the world; whereas, at the present time, it seems to be a fact that, at least in Germany, the e.m.f. of a Clark standard cell is officially accepted as 1.4328 international volts at standard temperature, while, at least in America, it is legally accepted as 1.434, according to the Chicago Congress—a small but appreciable difference that is capable of entering into significance when dealing with standard tests of incandescent lamps. Moreover, if the international commission asked for is successful, it is reasonable to hope that it may become permanent. In that happy event the various countries would be in constant intercommunication upon all matters of international importance relating to electromagnetic and cognate units. International agreement could thus be reached upon any new question that might arise, without the necessity of waiting for the next fortuitous convocation of an international electrical congress in connection with a World's Fair and its distractions. There can be no doubt that if the recommendation of appointing an international governmental commission meets with the success it deserves, the Chamber of Delegates of the St. Louis Congress will have done work at least as important for the electric arts and sciences as the Chicago Congress of 1893.

The second recommendation, that the various technical societies of the world appoint among themselves a commission to standardize the ratings of machinery, is also a valuable step in electrotechnical progress, if it can be brought to a successful termination. There can be no doubt that a given dynamo, built at any locality on the surface of the earth, ought to have one and the same rating everywhere. That is to say, it should not be capable of rating at, say, 100 kilowatts in one country and at 90 or 110 kilowatts in another country. In other words, the rating of a given piece of dynamo-electric apparatus or machinery ought to be the same all over the world, and not to be a function of latitude and longitude. Such ratings are obviously matters involving convention in connection with the universal laws of phsysics. There can be little doubt that a universal set of rules concerning the rating of machinery would be of general benefit to all countries. The recommendation of the Chamber does not extend to matters outside of ratings, and it would seem, indeed, unwise to attempt to standardize matters which lie outside of physical law, and which relate only to commercial and industrial local conditions. Nevertheless, if any international electrotechnical understanding and commission can be instituted according to the resolution of the Chamber, there is no reason why, if successful in the matter of ratings, the organization might not be made permanent; because even if it were judged inadvisable to carry standardization any further at present, yet the advantage which would accrue to the facilities for ready mutual consultation on any subject of general technical importance, should prove of great value to the societies of every country taking part in the work. Finally, in following the same avenue of international cooperation, it is quite possible that at some time in the future, all of the electrotechnical societies of the world may become closely interconnected instead, as at present, each working independently on problems that concern all.

Chamber of Delegates, International Electrical Congress, St. Louis, 1904.

The Chamber of Delegates of the International Electrical Congress of St. Louis, 1904, was organized on Monday, September 12, by the election of the following officers: President, Prof. Elihu Thomson; secretary, Dr. A. E. Kennelly; assistant secretary, Dr. F. A. Wolff, Jr., of the National Bureau of Standards.

After a general discussion as to propositions formally or informally brought before the Chamber, two committees were appointed to consider specified questions, the reports of which are given below. At the final meeting of the Chamber the reports of these committees were unanimously adopted and the recommendations contained therein accepted as the expression of the views of the Chamber.

It will be noted that no action whatever was taken on any propositions brought before the Chamber with respect to changes in present standards or units or additions thereto. The important work of the Chamber is the plan formulated concerning the appointment of an International Commission, to be named by Governments, for the consideration of such questions as have heretofore been brought before Chambers of Delegates meeting in connection with electrical congresses at World's Fairs. Favorable action on this plan will undoubtedly be taken, since it will be urged by the delegates at St. Louis on their respective governments. Such action will, of course, put an end to Chambers of Delegates sitting in connection with international electrical congresses.

Of but little less importance is the recommendation of the appointment of a body to consider the international standardization of electrical apparatus and machinery, the members thereof to be named, not by governments, but by the national electrical associations of the world.

COMMITTEE ON INTERNATIONAL ELECTROMAGNETIC UNITS.

The sub-committee appointed September 13, 1904, beg leave to suggest that the Chamber of Delegates should adopt the following report:

"It appears from papers laid before the International Electrical Congress and from the discussion that there are considerable discrepancies between the laws relating to electric units, or their interpretations, in the various countries represented, which, in the opinion of the Chamber, require consideration with a view to securing practical uniformity.

Other questions bearing on nomenclature and the determination of units and standards have also been raised, on which, in the opinion of the Chamber, it is desirable to have international agreement.

The Chamber of Delegates considers that these and similar questions could best be dealt with by an International Commission representing the governments concerned. Such a Commission might in the first instance be appointed by those countries in which legislation on electric units has been adopted, and consist of (say) two members from each country.

Provision should be made for securing the adhesion of other countries prepared to adopt the conclusion of the Commission.

The Chamber of Delegates approves such a plan and requests its members to bring this report before their respective governments.

It is hoped that if the recommendation of the Chamber of Delegates be adopted by the governments represented, the Commission may eventually become a permanent one.

That the delegates report the resolution of the Chamber as to electrical units to their respective governments, and that they be invited to communicate with Dr. S. W. Stratton (Bureau of Standards, Washington, D. C.), and Dr. R. T. Glazebrook (National Physical Laboratory, Bushby House, Richmond, Surrey, England), as to the results of their report, or as to other questions arising out of the resolution."

COMMITTEE ON INTERNATIONAL STANDARDIZATION OF ELECTRICAL APPARATUS AND MACHINERY.

The Committee of the Chamber of Delegates on the Standardization of Machinery begs to report as follows:

"That steps should be taken to secure the cooperation of the technical societies of the world by the appointment of a representative commission to consider the question of the standardization of the Nomenclature and Ratings of Electrical Apparatus and Machinery.

If the above recommendation meets the approval of the Chamber of Delegates, it is suggested by your committee that much of the work could be accomplished by correspondence in the first instance, and by the appointment of a general secretary to preserve the records and crystallize the points of disagreement, if any, which may arise between the methods in vogue in the different countries interested.

It is hoped that if the recommendation of the Chamber of Delegates be adopted, the commission may eventully become a permanent one.

That the delegates report the resolution of the Chamber as to International Standardization to their respective technical societies, with the request that the societies take such action as may seem best to give effect to the resolution, and that the delegates be requested to communicate the result of such action to Col. R. E. B. Crompton, Thriplands, Kensington Court, London, England, and to the president of the American Institute of Electrical Engineers, New York City."

Final General Meeting of the International Electrical Congress.

The sessions for the reading and discussions of papers brought before the International Electrical Congress at St. Louis were concluded Friday afternoon, September 16, and the following morning, after a short general meeting, the Congress was adjourned.

The final meeting was called to order by President Thomson, who, after voicing the satisfaction of all in attendance on the Congress at its great success, called upon Prof. Henri Poincaré. Prof. Poincaré expressed his regret at having arrived too late to take part in the proceedings of the Congress, of which he had been named an honorary vice-president, or of the Chamber of Delegates, to which he had been accredited by the government of France. Referring to the work of the latter, he heartily agreed with the recommendation that future action concerning the creation of, or changes in, units and standards, should be left to an international commission appointed by the various governments of the world, and which would not sit amid the distractions of a World's Fair.

Mr. Robert Kaye Gray and Prof. L. Lombardi responded for Great Britain and Italy, respectively, both warmly concurring in the conservative action of the Chamber of Delegates. Mr. W. Litzrodt, representative of the German government, when called upon, gave the floor to Prof. Arrhenuis, who responded for the other foreign countries represented at the Congress. Prof. Thomson then called upon Prof. A. G. Webster, president of the American Physical Society, to respond for the cooperating societies, who did so in appropriate and witty remarks that led to much applause. The fifth International Electrical Congress was then declared adjourned.

Courtesies to the Congress at St. Louis.

The telegraph and telephone companies were very generous at St. Louis in placing their facilities at the service of members of the International Electrical Congress. Both the Western Union and Postal Telegraph Companies established offices in the Coliseum Building for the accommodation of Congress members during the week, and the former company announced through the Congress *Daily Bulletin* that it would receive and transmit free, telegrams of Congress officers and delegates. The local telephone company had established a telephone in the office of the Congress in the Coliseum Building which all members were requested to use free of charge. The long-distance telephone company placed its service freely at the disposal of all Congress members during the week before 10 a. m. and after 6 p. m., and for the convenience of members established a booth in the Coliseum office of the Congress.

The American Telegraph & Telephone Company issued to all of the officers of, and delegates to, the Congress and to all members from abroad, a handsome morocco case enclosing a card, upon the presentation of which the bearer could use free of charge the Bell long-distance telephone service at any hour and over the entire system of the country. The city post-office established for the convenience of the Congress members a branch post-office in the main corridor of the Coliseum Building.

For the festivities attending the presence of the Congress at the World's Fair on Wednesday—Electrical Day—the Exposition authorities granted $1500 to Director Goldsborough, and placed at his disposal the World's Fair bands and every Exposition facility likely to add eclat to the day.

The Northern California Power Company's Systems.—III.

HIGH-TENSION TRANSMISSION SYSTEM.

GRAPHICALLY presented, the scheme of installation and distribution of the pole lines takes the form shown in the accompanying map of the system (Fig. 21), wherein the power generated in the Volta and Kilarc plants is transmitted first to the main switching station at Palo Cedro, whence emanate two lines known respectively as the Tehama and Redding circuits. The former, before teaching Tehama, traverses Anderson, Cottonwood and Red Bluff. In the Tehama sub-station the lines are again divided

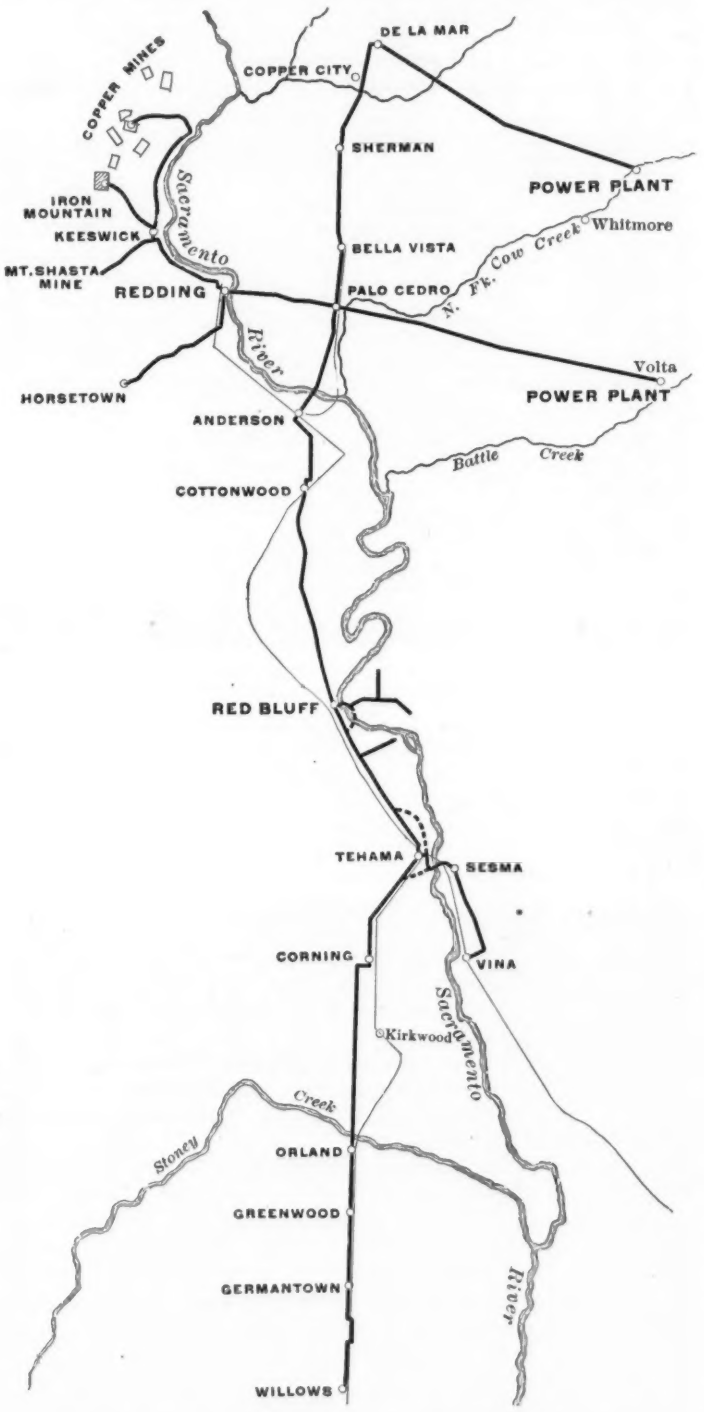


FIG. 21.—MAP OF POLE LINES AND DISTRIBUTING STATIONS.

into two branches known respectively as the Willows and Vina lines—the Willows line including Corning, Orland, Germantown and Willows, and the Vina line taking in Vina, which, by the way, is undoubtedly one of the most valuable pieces of viticultural and agricultural properties with which the Leland Stanford Junior University has been endowed. The Redding circuit is, however, the more important of the two main branches from Palo Cedro, for it supplies not only the city of Redding with light and power, but also the principal mining centers of Shasta County, which has a mineral production each year exceeding in value that of any other county in the State of California. Two transmission lines run out from Redding: one, the Keswick, runs direct from Redding to the Northern California Power Company's sub-station on the brow of the hill overlooking the canyon in which are situated the smelters of the Mountain Copper Company. From this sub-station the town of Keswick nearby is supplied with low-tension current; three-phase current at 2,200 volts is supplied to the power plant at the smelter for the operation of the works, and three high-tension lines, leading to the Mount Shasta, the Iron Mountain, and the Balakalala mines respectively, are also run out. The second transmission line from Redding is continued across the country in a southwesterly direction to historic Horsetown, the importance of which as a mining district is on the eve of revival through the inauguration there of mining dredging by a method and on a scale which is without precedent. There, a single electrically operated dredge—the "Lucky Jim"—which consumes from 700 to 800 hp, has just been finished and put into regular operation. Of this, however, more will be stated hereafter, for the dredge is not only unique in engineering design, but has a capacity and an efficiency never attained heretofore.

These transmission lines are all operated at an initial potential of 25,000 volts at the power houses, the transformers are in delta connection on both sides throughout, and as to the remaining characteristics of the pole lines in all the various divisions, they are fully presented in the accompanying table of physical data. From the figures there given, it is shown that the total length of transmission pole lines in the system is 193.9 miles, while the length of transmission circuits reaches the total of 228.4 miles. These figures do not include data on any of the local distributing systems, although it would be well to add thereto the length of lines used in transmitting power for irrigating purposes, which aggregate a total of eighteen miles in 2,000-volt, three-phase circuits. The total length of transmission circuits thus becomes 246.4 miles.

PHYSICAL DATA OF THE POLE LINES OF THE NORTHERN CALIFORNIA POWER COMPANY.

All are Single Pole Lines.

Division.	No. of circuits.	Line voltage.	Length in miles.	Size of wire.	Transposition.*	Δ sides in inches.
				No.		
Volta to Palo Cedro	2	25,000	20.0	4	6	30
Kilarc to Delamar	1	25,000	20.0	2	9	54
Delamar to Palo Cedro	1	25,000	18.0	4	6	30
Palo Cedro to Redding	2	25,000	8.2	4	3	30
Palo Cedro to Anderson	1	25,000	9.3	4	3	30
Redding to Keswick	2	25,000	6.3	4	2	30
Redding to Horsetown	1	25,000	9.4	4	3	30
Keswick to Shasta	1	2,000	4.3	4	none	30
Keswick to Iron Mountain	1	25,000	5.4	4	3	30
Keswick to Balakalala	1	25,000	12.8	4	3	30
Anderson to Cottonwood	1	25,000	5.0	4	1	30
Cottonwood to Red Bluff	1	25,000	16.0	4	2	30
Red Bluff to Tehama	1	25,000	12.4	4	3	30
Tehama to Vina	1	2,000	10.0	10	none	30
Tehama to Corning	1	25,000	8.0	4	3	30
Corning to Orland	1	25,000	12.5	4	3	30
Orland to Willows	1	25,000	16.3	4	3	30

Total length of pole line: 193.9 miles.
Total length of circuit: 228.4 miles.

*Number of transpositions per mile.

As is customary, the telephone circuits are run on all transmission pole lines, being placed on brackets on opposite sides of the poles at a practically uniform distance of 48 inches below the lower power crossarm. All telephone wires are of No. 12 B. B. galvanized iron wire and single metallic circuits are run on all pole line divisions except those from Volta to Palo Cedro, Palo Cedro to Redding, and Redding to Keswick, each of which is provided with a double metallic circuit. Although the telephone service is good, it is not regarded as perfect at all times, in view of which considerable experimenting in the way of transpositions is under way.

In the main the poles are of round Oregon cedar, uniformly in 30-foot lengths with 8-inch tops, but in the towns 35 and 40-foot redwood poles are used, and throughout, the line, which is of hard drawn copper, is supported on Provo No. 1, 40,000-volt glass insulators. These, in turn, are mounted upon 1½-inch by 12-inch eucalyptus pins, supported by 3¾-inch by 4¾-inch Oregon pine crossarms. Both pins and insulators were treated with boiled linseed oil after having been kiln dried. Switching sub-stations are maintained at Palo Cedro, Redding, Keswick and Tehama. Palo Cedro proper is merely a little cross-roads settlement without special importance, and the Palo Cedro switching station is located about a mile there-

from in a southerly direction. From it, the line to Anderson follows along the right of way of the Terry Lumber Company's railroad, south to Anderson, thence along county roads via Cottonwood to Red Bluff, whence it continues along the right of way of the Southern Pacific Company's Oregon Line, or rather its "Shasta Route," to Tehama, which is, as stated, another switching and sub-station. From Tehama to Vina the line continues to follow the road of the Southern Pacific Company, but the Willows line strikes out into a magnificent stretch of fruit and farming country in a due southerly direction, passing en route the towns of Corning, Orland, Greenwood and Germantown. Willows, the terminus of the line, is, by the way, just 32½ miles due west of Oroville, where are located the gold dredging fields of the Feather River, which have thus far proved to be the most extensive and profitable to be found in the country and which constitute, moreover, the most lucrative territory served by the transmission lines of the California Gas & Electric Corporation.

The sub-station for Redding is located on the bank of the Sacramento River, at a distance of about 7,500 feet from the court house, which practically marks the centre of the town. It is of rubble work with concrete floor and corrugated iron roof supported on angle iron trusses, its dimensions being 18 by 26 feet. After crossing the river in a single span of 600 feet, one of the double-circuit lines from Palo Cedro enters it, while the other continues on direct to Keswick, 6.3 miles to the northwest. A tap is, however, taken off the latter and both lines are thus connected to two sets of double-pole "M-T" switches, so that while Keswick service runs through straight, service for Redding and Horsetown may be taken from either of the main lines from Palo Cedro, parallel or separate connections. The sub-station further contains a set of three 6.3-ampere static interrupters and lightning arresters of standard Westinghouse form, and three 150-kw Westinghouse, oil-insulated, air-cooled transformers, the latter being in reserve. The entire local load is carried by the three "S. K. C." transformers which deliver two-phase, four-wire current at 2,200 volts, primaries being delta connected.

This sub-station is, therefore, merely a step-down transformer station, for the local distributing circuits are handled from the water works and electric light plant located a few rods distant. This plant, now referred to as the "Water Works," has been largely dismantled since the completion of the transmission system, but originally its steam-electric equipment consisted of two 60-hp "Keystone" return tubular boilers; a 200-hp St. Louis Corliss engine; a 50-kw, two-phase, 2,000-volt Westinghouse generator; a 75-kw, 2,000-volt Westinghouse single-phaser, and a 50-light Western Electric arc ma-

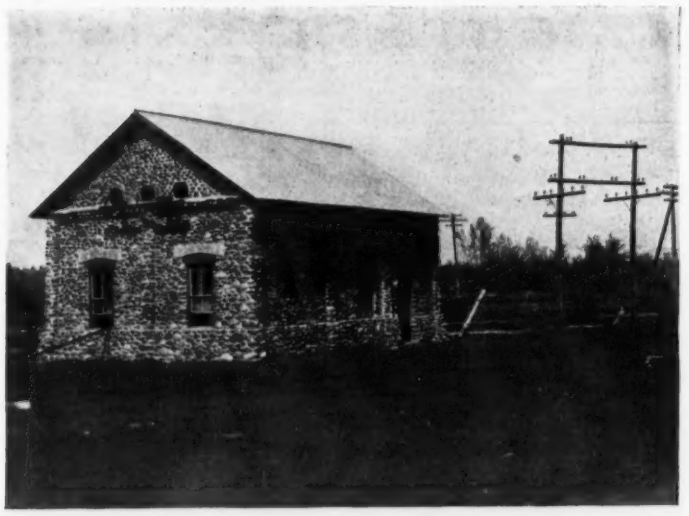


FIG. 22.—REDDING SUB-STATION.

chine; these dynamos being driven from a counter-shaft that in turn was run by the engine, or by two Victor turbines, or both. Water for the operation of these turbines was taken from the Sacramento River, 1½ miles above, and delivered thereto through a large wooden flume under a head of ten feet. Both flume and turbines are now out of commission and the steam plant is dismantled save for the boilers which are ready to operate the water works should necessity so require. The water works equipment consists of two double-acting duplex pumps built by the Fulton Iron Works, San Francisco. These are belt-driven from the counter-shaft. For reserve there is a Dow tandem compound steam-driven pump. These pumps operate on the direct-pressure system, carrying a maximum of 90 pounds per square inch. Motive power for the operation of the pumps is supplied by two 50-hp, "type C," 2,200-volt, two-phase induction motors, and the old Westinghouse 50-kw, two-phaser used as a synchronous motor, belted to the counter-shaft.

From the sub-station, current is led direct to the local distributing switchboard, which occupies a position on the easterly side of the water works thoroughly convenient to the attendant, who finds no difficulty in caring for both the water and electric systems. This switchboard consists of three marble panels of local manufacture. First is the total output panel, containing two ammeters, a voltmeter, a wattmeter, a voltmeter plug switch, two General Electric, 2,500-volt oil switches and two sets of fuses. The second, known as the irrigating panel, which carries a load of approximately 80 kws per phase, contains two ammeters, two General Electric oil switches and two sets of fuses. Finally, the third panel, called the Redding

FIG. 23.—KESWICK SUB-STATION LOOKING NORTHEAST.

panel, carries two ammeters, a voltmeter and plug switch, and General Electric oil switches and fuses, and from it are run two two-phase circuits of No. 4 copper which, though separate on the pole lines, are tied in at both ends. All instruments listed on this switchboard are of standard Westinghouse make, except where otherwise stated, and in addition thereto the incoming leads are provided with two "type C R" General Electric regulators having a capacity of 15 kw each and capable of a range of 10 per cent. in either direction. The motors which drive the main counter-shaft are started and controlled by means of auxiliary panels placed adjacent to each of them, which accounts for their not being given a panel on the main switchboard.

The particular interest which is attached to this station, therefore, lies in the fact that in it are combined under the charge of a single attendant the entire water, irrigating and electric services of an important and populous community.

Gas works are maintained by the company in both Redding and Red Bluff, but of them there is really little to be said, for the service they render is small, because their development is hardly under way as yet. The plants are practically identical in the two towns, and to describe one is to describe both. That at Redding, therefore, consists of a Lowe crude-oil set, technically known as a "No. 3" set, which has a capacity of 100,000 cubic feet of 23 candle power gas per day of twenty hours. A 40-hp return tubular boiler supplies steam for the generator and oil and water pumps, as well as for a No. 1 Jewel simple engine which drives a No. 3 "Monogram" blower. No relief holder is provided, but the main holder consists of a 10,000-foot iron body floating in a wooden tank placed on the surface of the ground. In the two towns there are about 16 miles of gas mains, which range in sizes from four inches to one-inch services. Gas sells at the rate of $2.00 per thousand, with no reduction for use as fuel.

Keswick, though not distinctive as a place of beauty, is undoubtedly a joy forever to the stockholders of the Mountain Copper Company, an English corporation, which holds the distinction of operating the largest copper property in California. Vegetation

abhors a smelter; hence Keswick is a community without lawn mowers. Not a leaf of foliage nor a spear of grass are to be found anywhere thereabouts, and the streets are as dusty as the Hangtown crossroads, for, though means for irrigation abound, they are all of the inward variety. And as for smoke, Prof. Thomas Price, the eminent chemist, of San Francisco, is authority for the statement that 1,200 tons of sulphurous acid gas are belched forth from the chimneys of the smelters each day of 24 hours. Well may this be so when it is known that the ores handled contains 45 per cent. of free sulphur. Nevertheless, it is a magnificent property and one which gives a mighty impetus to the prosperity of Shasta County—

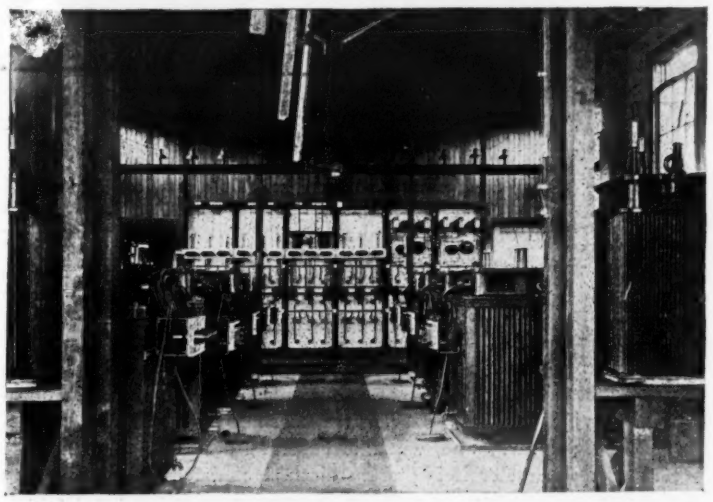


FIG. 24.—INTERIOR OF KESWICK SUB-STATION.

which makes it, in fact, the most important mining county of the State.

The town of Keswick is irregularly laid out on a site of little rolling hills, to level which no effort whatever has been made, although it would not be difficult to do so. Just beyond it, over in a comparatively narrow canyon, are located the works of the Copper Company, the smoke from which forms a landmark for the whole northerly end of the great Sacramento valley. A knoll on the southerly side of the canyon has afforded an admirable location for the Keswick sub-station of the Northern California Power Company. This is built of red brick, 26 by 50 feet in size, with an addition 10 by 12 feet in size on the lower side, with concrete floors and a P. & B. covered wooden roof. As is the case with all stations

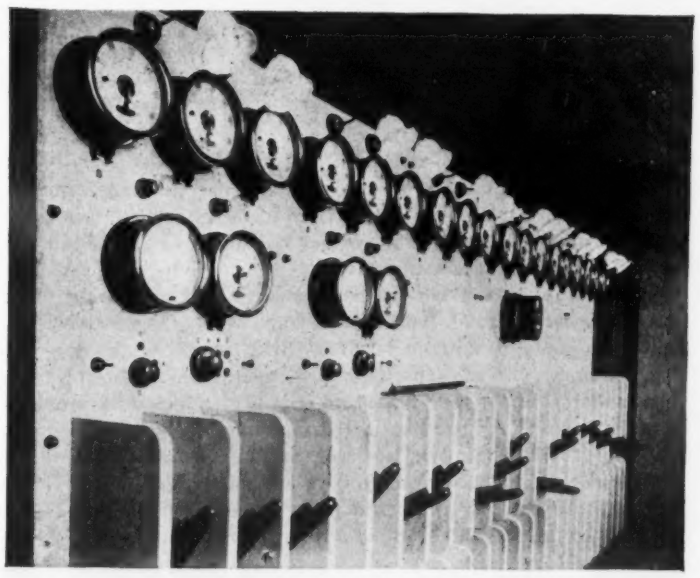


FIG. 25.—SWITCHBOARD KESWICK SUB-STATION.

of the Power Company, it is most excellently maintained and is a splendid specimen of neatness and adaptability.

The power line from Redding enters the front or easterly end of the sub-station through the conventional sewer tilings, upon which a set of three static arresters and high-tension "M-T" switches are respectively connected. These latter are four in number. The "northside" set throws the bank of transformers on the north side of the sub-station to either line, the "southside" set similarly throws the south bank of transformers to either line, the third set controls the 14½-mile line running to Balakalala sub-station, and the fourth set controls the 5-mile line running to Iron Mountain, which is the location of the copper mine of the Mountain Copper Company, and whence ores are brought to the Keswick smelters in standard broad-gauge steam ore trains. The 2,000-volt line supplying current to the old and moth-eaten town of Shasta (though it forms a beautiful home place for those who are employed at the smelters) is run from a panel of the switchboard in the Keswick sub-station. It is of standard construction, ready for high-tension current when the load becomes heavy enough to warrant the change.

The transformers in the Keswick sub-station are six in number, with one more for reserve. They are each of a capacity of 150-kw, of the oil-insulated and air-cooled Westinghouse type, and deliver three-phase current at 2,000 volts for consumption in and about the smelters and in the town of Keswick. The distributing switchboard in this sub-station is novel in that as one enters the station its rear side is presented to view, running along the easterly end of the station in line with a partition that reaches to the ceiling. A door at either side of the switchboard affords entrance to the front of the board which, with the telephone equipment, occupies all there is to the narrow room, eight feet wide by the width of the station in length, which forms the rear end of the building. This

FIG. 26.—IRON MOUNTAIN SUB-STATION.

switchboard is in six panels, laid out with double busses for handling the two sets of transformers on the various classes of service to be detailed. The first two panels receive current from the respective banks of transformers, and each contains three 200-ampere Westinghouse ammeters, one wattweter, one voltmeter and plug set, one ground detector, together with six 2,000-volt, single-pole, quick-brake knife switches with marble divisions—all instruments throughout the board being of Westinghouse manufacture. The third panel, which controls the station lights, contains three 200-ampere ammeters and six similar quick-break switches. The fourth panel—that for the smelters—contains three 200-ampere ammeters, a recording wattmeter and the conventional six quick-break switches. The fifth and six panels, which are alike and which control respectively the 2,000-volt circuit leading to the Mount Shasta mine and to the town of Keswick, each contain three 200-ampere ammeters and six quick-break switches.

It is but 500 feet or so down the hillside from the sub-station to the power plant building at the smelters, where the 2,000-volt circuits are manipulated for local distribution. This was originally a steam plant, and as the engine has been allowed to remain in position, and steam is always available from the battery of Babcock & Wilcox boilers in the boiler house adjacent, steam power may be substituted for electrically transmitted power at any time on shortest notice. A thoroughly substantial brick vault that is partly underground houses the four 75-kw Westinghouse "O D" transformers which are used for reducing such low-tension cur-

rent as is required to 110 volts—one of these transformers is a "spare," and the remaining three feed into three busses on the three-wire system with 110 volts to the side. All the remaining current used about the smelters is distributed at 2,000 volts in three-phase delta connection.

A seven-panel switchboard of marble occupies the easterly end of this power house. The total output is measured and handled on the first panel, which contains a 200-ampere ammeter, a recording wattmeter, ammeter plug and a ground detector. The second and third panels each contain six 2,200-volt oil switches; the fourth panel panel is blank; the fifth, which is the lighting panel, contains three 400-ampere ammeters, one 150-volt voltmeter and plug, a ground detector and six double-pole, double-throw switches with phase letterings on their clips to enable the balancing of sides. The voltmeters and ammeters above listed are of the Westinghouse type, but on the sixth and seventh panels Weston instruments are used. These are direct-current panels used for the control of three 37½-kw, 125-volt, direct-current multipolar generators which are belt-driven from the counter-shaft that runs along the length of the station and which are, in turn, driven by belting from one 100-hp, "type C" Westinghouse induction motor operated from the 2,000-volt, three-phase circuits. These final panels contain three 400-ampere ammeters, two 150-volt voltmeters, one 300-volt voltmeter, three General Electric circuit-breakers, three field rheostats, four single-throw, double-pole knife switches and one triple-pole, single-throw knife switch that is used for paralleling two generators when necessary. Normally, two generators are run in series for the purpose of providing 250-volt current for the operation of the slag train, about to be described, and the 25-ton electric crane which travels along the converter building. Around the buildings and grounds are some 1,200 16-cp incandescent, and 50 4-ampere, alternating-current arc lamps which are ordinarily run from the three-wire, alternating-current circuit, but in event the normal supply is interrupted, the manipulation of switches on the direct-current panels enables direct current to be substituted for alternating current with satisfaction.

The most striking use of electric power in and about the smelters centers in the electric tramway by means of which the molten slag is taken from the converters and carried to the slag dumps, three-quarters of a mile down the ravine. Ordinarily six cars constitute a train, but at times seven cars are run; each car consists of a single four-wheeled truck with no springs supporting a cast-iron pot averaging 6,020 pounds in weight. Each pot has a capacity of about 25 cubic feet and weighs about 2½ tons loaded. The molten slag is run into the pots by means of clay-covered spouts leading from the furnaces wherein the ore is melted, and to facilitate loading the train is broken up into sections so that three or more pots may be loaded at once. This breaking up and switching of the trains into sections, which is called "spotting," is attended to by one or the other of two small General Electric electric locomotives, each of which is equipped with two 12½-hp motors provided with R38 controllers. Current for their operation is taken at 250 volts from an overhead trolley system consisting of No. 00 hard-drawn copper without feeders.

The small General Electric locomotives are, as stated, used mainly for switching inside the yards, for the duty of taking the pots to the dumps is entrusted to a Baldwin-Westinghouse electric locomotive which, though no more powerful than the smaller ones, is given the preference in making the outside run because of its heavier weight, namely, 13,600 pounds. This is also equipped with two 12½-hp motors in series-parallel connection through an R37 controller. The loaded train is taken down the ravine at a decline of approximately 2 per cent., the braking therefor being all done by the locomotive, which occupies the rear end of the train in descending. The locomotive is, therefore, under heaviest load in bringing back the empty cars—a duty which occurs about three times per hour. This train travels approximately 30 miles per shift of twelve hours, and it, as well as the "spotting" locomotives, are in continuous service day and night the year through.

Pennsylvania Independent Telephone Association.

A call has been sent out to the independent telephone companies of Pennsylvania to meet at Harrisburg September 27 and 28 to form a State association. Fifteen companies signed the call, including the Keystone Company, of Philadelphia.

Testing of Large Capacity Induction Wattmeters.

BY E. W. GOUGH.

In the case of companies furnishing large amounts of electrical energy, small percentages of error in the recording of the instrument upon which the energy is sold may mean a very considerable amount in dollars and cents in the returns received, consequently it is of the utmost importance to such concerns to know the exact error of the measuring instrument. It can readily be seen that the loss resulting from a meter showing an error of, say, 4 per cent. slow in a station, developing 100,000 kw-hours per day would represent a loss of 4,000 kw-hours to which, of course, must be added the various other losses.

The situation quite frequently presents itself to operating companies of testing wattmeters, which are installed on circuits carrying large currents; that is, currents of say 500 amp. and above, or circuits operating at high voltages, where it is impossible, or at least very undesirable, to open the circuit in order to determine the meter's accuracy. This condition is especially met with in stations operating at primary voltages, where it is impossible to open the circuit at any time during the twenty-four hours in order to obtain checks upon the meter's rate. To meet this condition, certain types of instruments are calibrated by the makers without reference to the current transformers (which are usually furnished with meters of large capacity and meters of voltages above 1,000). Each meter is operated in connection with a current transformer whose ratio of transformation is known, and when it becomes desirable to check the accuracy of the meter it is merely disconnected from the secondary of the current transformer without interfering with the main circuit in any way. The method is very convenient, but it is assumed that if the meter operates correctly without the transformer on any non-inductive load on which it may be tested, that when connected with a current transformer it will possess the same degree of accuracy. Certain other factors are apt to come in, however, and totally change the accuracy of the instrument, such as slight errors in the ratio of transformation of the current transformer, loss in the leads and connections between the secondary of the current transformer and the meter winding, inductive effect in the secondary leads, etc.

Various methods have been employed to determine the accuracy of meters of this character, but under ordinary station conditions it is frequently very difficult, by means of indicating instruments, to obtain results which can be absolutely relied upon; moreover, slight changes of voltage and frequency affect all induction apparatus to a greater or less extent, and induction wattmeters are no exception to the rule. Consequently, instruments which are calibrated under one set of conditions will not show exactly the same results under all other conditions of voltage and frequency found in commercial station operation. These variations, however, are properly taken into account when using a recording standard, as they affect similarly both the meter to be tested and the standard.

A method which has been found to work quite satisfactorily consists in initially calibrating the meter and its current transformer together, and after the apparatus has been installed in circuit, in checking its accuracy under its own working condition, by surrounding the conductor carrying the current to be measured by a series transformer having only a single secondary winding and being of the closed magnetic circuit type. This transformer, together with its connecting leads, is initially calibrated with another recording wattmeter, preferably of the same type as the meter which is being tested.

In carrying on a test of this kind it is preferable to have a meter which is geared up so that its revolutions register quickly on a suitable dial. The test can, however, be conducted with any recording meter by merely starting the two meters together and letting them run until one or the other gains or loses a revolution; if the meter to be tested gains one revolution on the standard in say, 100 revolutions, it is obviously fast 1 per cent., assuming, of course, that both meters have the same constants.

The advantageous features of this method are that the meter in service is calibrated initially with its own transformer in connection with it and with the length of leads used under operating conditions. The test meter is also calibrated with its transformer and the length of leads to be used with it, but the transformer of the test meter is so designed that it can be readily put into commission without interfering with the operation of the circuit.

Power Transmission Before the International Electrical Congress.

LAST week the pages of ELECTRICAL WORLD AND ENGINEER contained quite full reports of several of the most important papers read before the power transmission section of the International Electrical Congress at St. Louis, together with notes of some of the discussions. We are now able to supplement our telegraphic outlines by fuller data from editors on the ground.

SECTION D.—POWER TRANSMISSION.

MONDAY.

The proceedings of Section D, Power Transmission, opened Monday morning with Chairman Charles F. Scott in the chair. A paper by Sig. E. Bignami on "Electrical Transmission Plants in Switzerland" was read in abstract by the secretary, Dr. Louis Bell. This paper was mainly of a statistical nature, giving the number of plants, sizes, voltages, character of current and other engineering details so that an opinion might be formed of the current practice in Switzerland. From the paper it would appear that Swiss practice is not so uniform as in this country. The most usual frequency is 50 and there are a number of direct-current transmissions.

Chairman Scott, in opening the discussion, remarked on the large number of such installations in a comparatively small country. Dr. F. A. C. Perrine commented on the high-load factor in the Swiss plants, most of which had a load factor of over 50 per cent. This showed good management and attention to details. In the United States many plants had a load factor of 30 per cent. and less, owing to the nature of the load, which has high peaks. The average volts per mile in American transmission practice is 600 to 850, which is more than in Switzerland. The most successful United States power transmission companies were those which had a number of power stations located at different points and all connected in parallel to a network of high-tension lines. This had been done sometimes even with the plants of rival companies. He cited a case where when the power house of one company was disabled its load was taken by another company so that power was for a time transmitted 296 miles. This connecting of different stations in parallel had reduced the importance of providing steam-driven auxiliary stations for use in emergencies.

Chairman C. F. Scott then announced that he had hoped to have prepared for this congress a history of long-distance power transmission in California. Since his arrangements for such a paper had failed he had himself prepared a short history of the first transmission work in this country. This he read. He called attention to the newness of power transmission. At the International Electrical Congress in 1893, at Chicago, he had received the first official announcement that alternating current was decided upon for the Niagara plant. At the present time the leading American manufacturers had supplied approximately 1,250,000 kw in generators for use in long-distance transmission, and there were a number of great networks of transmission lines supplied by a number of power stations operated in parallel. The adoption of polyphase current for the Niagara plant had undoubtedly given a great impetus to the use of polyphase current for transmission. He commented on the fact that only about one-third of the Niagara plant output is now utilized for the electric light and general power purposes originally thought of. The balance is used by electrochemical industries which have sprung up since the plant was first designed. In behalf of the officers of the section he said that he (the chairman) was intimately connected with the Telluride, 100-hp, single-phase transmission in 1891, and Dr. Bell (the secretary) was, when at the 1893 congress, on his way to start the polyphase transmission at Redlands, Cal., which was among the first in America.

Dr. Bell, continuing these reminiscences of the early work in America, told of a contract which he received as a heritage in 1892 for transmitting 150 hp five miles at Walla Walla, Wash., by 2,000-volt direct current. As no maker would attempt to build such a direct-current machine he persuaded the parties to use single-phase synchronous motor and generator. At Concord, N. H., and Taftville, Conn., were other early polyphase transmissions. At the latter place he told of an amusing experience in keeping the plant operating by "snowballing" some of the strain insulators with dirt balls all one afternoon in order to prevent incipient arcs across the insulators from causing a shutdown.

Mr. E. Kilburn Scott said he considered the selection of polyphase current for the Niagara transmission undoubtedly was the result of its success on the Tivoli-Rome line. Ferranti had demonstrated in London the commercial possibility of transmitting at 10,000 volts over paper-insulated cables. Was not much of the wonderful development in California due to the simplicity of the plant using high heads and tangential water-wheels and to the clearness of the water, which was free from troublesome vegetable growths they had in England?

Mr. Hutton showed that the water in California is by no means always clear and frequently necessitated elaborate settling basins. Formerly considerable trouble was experienced with cutting out of wheel buckets by the grit, but that is not now serious. His company had just started a plant with 1,800-foot head with an overhung tangential water-wheel having a single 6-inch nozzle.

Chairman Scott said that one of the "geological conditions" in California that had as much to do with the development of power transmission as the high waterfalls was the absence of coal. Mr. Walters pointed out that the first long-distance polyphase transmission was the Frankfort-Lauffien, 100-mile, 30,000-volt experiment at the exposition of 1891.

TUESDAY.

Section D, on Tuesday, was opened by the reading of a paper by Mr. J. S. Peck, on the "High-Tension Transformer in Long-Distance Power Transmission." He pointed out what an important element the transformer is in long-distance transmission and what great improvements there must have been in transformer construction in ten years when it is considered that in 1893 so little was known of insulating materials that a transformer wound for 10,000 volts involved great hazard. Now 60,000-volt transformers could be built with certainty that they would be a success. Transformers could be divided into three general classes: (1) Air blast. (2) Oil insulated, air cooled. (3) Oil insulated and water cooled. Another class sometimes used was cooled by circulating the insulating oil through cooling coils outside of the transformer. The fire risk with oil-insulated transformers had been much discussed lately. He did not consider there was much risk because the oil used was not combustible except at high temperatures. It was now common to put a very tight case on transformers to reduce the fire risk. He presented curves showing the increase in manufactured output of transformers from 1892 to 1903; also curves showing the increase in maximum and average capacity of transformers manufactured each year, and the increase in maximum and average voltages. The latter had increased from an average of 3,000 volts and a maximum of 10,000 volts in 1893, to an average of 20,000 volts and a maximum of 60,000 volts in 1903. He also gave curves showing the principal characteristics of modern transformers.

Mr. F. O. Blackwell, in discussing this paper, did not agree with Mr. Peck about fire risks. He thought the storage of a large amount of oil in transformer cases was analogous to the storage of a lot of lubricating oil, for example, and as much care should be taken to isolate the oil-insulated transformers as the supply of lubricating oil for a power station. He recommended the building of a station with fireproof and airtight compartments for the transformers. Such compartments could be compared with the varnish tank compartments used in a certain factory for containing the varnish vats used for dipping coils. In case a vat took fire it had been demonstrated that it was only necessary to close the compartment and the supply of air being soon exhausted the fire would go out. He called attention to the great saving in first cost by sacrificing a little in efficiency. A transformer of 96 per cent. efficiency could be obtained at about one-half the cost of the same capacity with 99 per cent. efficiency.

A discussion started by Mr. E. Kilburn Scott as to whether cooling ribs both inside and outside of a transformer case would not increase the radiating ability, brought out the fact that such ribs were of no value on the inside, as the heat would pass from the oil to the metal much more rapidly than from the metal to the air. Dr. Bell said that while it was quite possible to enclose transformers completely in fireproof compartments, it was at the expense of simplicity. Much trouble might be avoided by not trying to make a station too compact. Plenty of room in a station or what might even be called waste space was frequently one of the best forms of insurance that could be carried.

Some questions were raised about securing of good oil, especially in England. Mr. Walters, of the latter country, said the only way to be sure of good oil was to purify it yourself. His company dried

out the moisture by heating the oil with steam coils in a case and afterward filtering to take out impurities.

Mr. F. O. Blackwell cited a recent case where an oil did not have anywhere near the dielectric strength that it had at the factory. It was brought back to standard by pumping hot air through it. The trouble was with the barrels, which were not perfectly dry before the oil was put into them for shipment.

Mr. J. S. Peck said that transformer oil must be a mineral oil bought under rigid specifications as to freedom from moisture, acids or alkalis. Oil in transit may absorb moisture.

Professor Harold B. Smith read his paper entitled "Notes on Experiments with Transformers for Very High Potentials." (See E. W. & E., p. 469, Sept. 17.) This was followed by Mr. F. G. Baum's paper on "High Potential Long-distance Transmission and Control." (See E. W. and E., p. 469, Sept. 17.) This paper drew out a lengthy discussion and much praise because of the data it gave from practical experience with the immense California Gas & Electric Company's system with over 700 miles of line and potentials approaching 60,000 volts. In concluding his paper Mr. Baum emphasized his belief that very high voltages are best for lines over 50 miles in length and are to be chosen in preference to low voltages because experience had shown them to be more free from trouble. Lightning troubles the highest voltage lines the least, and the rise in voltage caused by surging upon breaking a short circuit would be less with the higher voltages by the formula he derived in the paper, which gave this rise in voltage as 200 times the interrupted current. The higher the voltage the less this current, therefore the less the voltage rise.

In response to questions Mr. Baum stated that the air gap on the horn type lightning arresters on a 60,000-volt line is about 4 or 4½ inches between each leg and ground, one such gap being used. A line at 50,000 volts was operated through the city of Oakland. A lengthy controversy arose over the usefulness of the horn type lightning arrester. On Mr. Baum's big California network the simple horn type arrester had operated successfully to the extent that it almost never short-circuited the station when it discharged and no trouble was experienced from lightning, though to be sure lightning was infrequent in that country. Every type of multiple gap arrester had been tried and purned up on these lines. While the horn arrester might not do for some other places where there was much lightning, it had the merit here of giving the least trouble and being cheap, as there was nothing to burn out about it but a few feet of bare copper wire.

Dr. Perrine said the point of the paper was not lightning arresters. The important point was that they had here a great system which was free from the majority of the minor difficulties usually discussed. The use of very high voltage with small current almost wiped out the dangers of surging upon opening short circuits. In the paper no mention was made of artificial regulating drives for compensating for leading currents due to capacity or lagging currents due to induction, because with a system fed at many points and supplying current at many points as in this case, such difficulties disappear. Thus the very complexity of the system is the secret of its successful operation.

Dr. Bell agreed with this, but pointed out that the ordinary transmission was not of this class. Mr. Baum, illustrating the flexibility of his company's system, showed how, on one occasion, when the hydraulic plant at one of the power houses was being repaired, power was transmitted 350 miles, and the disabled power house being near the end of this line a generator was started as a synchronous motor to supply lagging current to counteract the condenser effect of the long line.

Mr. M. H. Gerry, Jr. thought the limiting factors of high potentials would be the accessory apparatus, such as switches, lightning arresters, etc. Mr. Baum disagreed with Mr. Gerry, as he was ready to build switches for 100,000 volts, and thought arresters would give less trouble at that voltage than at present. The line insulators limited the voltage.

Dr. F. A. C. Perrine read his paper on 'American Practice in High-Tension Line Construction and Operation," explaining in introduction that it was written with the idea of summing up American practice for the benefit of foreign members of the congress. (See E. W. and E., p. 469, Sept. 17.)

THURSDAY.

Section D on Thursday morning opened its session by listening to a paper by H. W. Fisher, on "Sparking Distances." This paper gave the results of extended researches by the author on the sparking distances between sharp points corresponding to different voltages. One of his efforts was to determine the methods of arranging points which would give the most uniform results. He used concave discs a short distance back of the points. He found that the sharpest points would not give the minimum sparking distance, but that points having a diameter of .003 inch would give this.

After the reading of the paper, in response to a question from Dr. Bell, the author stated that the use of ordinary commercial needles just as they come from the package is likely to introduce variation or errors of 2 to 3 per cent. C. E. Skinner spoke of the sparking method of determining very high voltages, having been formerly used in connection with insulation tests, but having been abandoned because of the errors likely to creep in.

H. W. Buck then read his paper on "Aluminum as an Electrical Conductor." He enumerated the legitimate uses of aluminum in electrical work for appliances such as bus bars, high-tension line conductors and low-tension feeders not requiring insulating covering. On account of its large cross section for a given conductivity, it is not suited to interior wiring or locations where an insulating covering is required. Aluminum is difficult to solder, probably because it is always covered with a very thin film of oxide. But aluminum has now reached the place where its use is no longer an experiment. The early troubles from breaking at unexpected places have been overcome in the present stranded conductor. It is durable except when exposed to sea fog and in the neighborhood of chemical fumes, and the wire can be given a weatherproof covering when such districts are passed through. The trouble from sleet seems to be less with aluminum than with copper conductors. It costs less to transport and string than copper because it is lighter. When stringing in rough country, however, more care is necessary than with copper to avoid abrasion of the soft aluminum conductors. Soldering aluminum joints has not been found necessary. Aluminum high-tension wires should be placed as far apart as possible to keep down the volume of current that flows when an accidental arc is established between them, and so prevent as far as possible the melting of the metal by the heat. A long arc will be blown by the wind and will not concentrate at one point. To determine wind pressure on spans, he had erected a platform at the middle of a span. The position of the cable with no wind blowing was carefully marked first, and afterward the dynamometer pull required to pull it back to the mark with different wind velocities was noted. This gave the wind pressure for half the length of the span. He found that $P = .0025\ V^2$ when P = wind pressure per square foot of cable exposed. V = actual velocity of wind. Maximum velocity of wind never occurs at lowest temperatures. Wind of over 76 miles per hour does not blow except in tornados—the latter being too violent to build against. He did not take sleet into account in his calculations because it was the universal experience that sleet did not form on high-tension lines.

The paper by F. O. Blackwell on "Conductors for Long Spans" was then read by Paul M. Lincoln, so that both the Buck and Blackwell papers could be discussed together. (See E. W. and E., p. 473, Sept. 17.)

P. N. Nunn, in discussion, questioned whether in actual practice the deflection of aluminum spans under highest temperatures is more than copper, because aluminum is usually strung so that it has enough less deflection than copper in the coldest weather to make the deflection not in excess of copper at the highest temperatures. Aluminum conductors are most apt to be broken by arcs. In the five years' experience that the Telluride Power Transmission Company had had with aluminum on lines in Utah and Montana, he remembered but one break not due to an arc. C. W. Hutton said that in crossing valleys the California Gas & Electric Company had been trying long spans. There was one 1,800-foot span of aluminum cable. There was no trouble from crossing of wires in the wind as all conductors would swing in unison.

V. G. Converse presented a paper on "High Tension Insulators." He gave drawings and brief descriptions of the principal highest voltage insulators from 1893 to 1904. Some of the latter for 60,000 volts were 14 inches in diameter and weighed 25 pounds. Possibly the insulator of the future for higher potentials and long spans would weigh several hundred pounds. He outlined the tests which should be applied to insulators.

Chairman Scott, in discussion, said that some of the latest insulators might seem rather formidable as to size and cost, but after all the insulators are likely to be a very small item in cost of plant.

One case figured on recently showed that the cost per kw of plant capacity for insulators was such that fixed charges on insulator investment were only 2 cents per kw capacity per year.

"High Tension Transmission Lines" was the subject of a paper by M. H. Gerry, Jr., which was then read. (See E. W. and E., p. 473, Sept. 17.) Mr. Gerry at the close of his paper spoke of the discussion that had been going on regarding the relative merits of iron and wood pins. He thought there was no room for argument. The wooden pins were better because they had the practical effect, if they were properly treated, of adding that much extra insulating material in the center of the insulator and increasing the thickness of the dielectric. Of course that part of the pin which was exposed to rain was of no value as an insulator, but the end of the pin had a value in virtually increasing the thickness of the insulator, just under the wire, that should not be lost sight of. He thought the burning of pins was due to a too thin dielectric at the head of the pin. Mr. Converse agreed with him on the latter point. Chairman Scott said Mr. Gerry held the record of being the first to operate at over 50,000 volts, having started such a line two and a half years ago, and that his experience was therefore of value. Dr. Perrine described an insulator something like a Chinese pagoda which he thought designed on theoretically correct lines which had several petticoats, each petticoat being curved outwardly so that all parts of its surface in a given plane were equally distant from the edge of the petticoat next above. This gave no one point of much higher potential stress than any other. Dr. Bell criticised some of the recent attempts to build insulators of enormous size. It was out of the question to secure good porcelain in such enormous tubs. He summed up the iron and wood pin controversy by pointing out that the iron pin is feasible if the insulators are made electrically strong enough to permit bringing ground up into the insulator. If they were not strong enough for this, the wood had an insulating value that would materially help. Mr. Hutton then told of trouble with the umbrella type of insulator by the collection of salt dust from fog. After such insulators had apparently broken down they were cleaned and tested and were frequently put back in service as good as ever.

FRIDAY.

Friday morning Section D took up the paper on "High Tension Transmission," by J. F. Kelly and A. C. Bunker, which was read by Mr. Bunker. (See E. W. and E., p. 473, Sept. 17.) The general subject of this and the Gerry paper being open for discussion Mr. Bunker took exception to Mr. Gerry's ideas on wooden pins. In some places he had had wood pins rot or mold inside of six months. In other places they would last indefinitely. Dr. Bell pointed out that wood pins are frequently not treated properly. It was not sufficient to treat them by simply boiling in paraffin. Putting them in vacuo would take the steam out of the pins and allow the paraffine compound to enter as no amount of boiling would. What Mr. Bunker called moulding of the pin was really due to brush discharge. Mr. Bunker cited his experience with a 40,000-volt line exposed to salt and marsh winds where certain insulators on wood pins were causing as high as 60 breakdowns per month. The substitution of iron pins for wooden ones under the same insulators reduced the trouble almost to nothing. P. N. Nunn appeared as the champion of the wood pin and the all-wood pole line construction as well. Some people, he said, pointed to the insulators on his Provo line and said, "Of course wood pins must be a success with such insulators"; others pointed to the wood pins and said, "Of course such insulators would be a success with such long pins." Practical success was better than theories. He did not know that his Utah lines ever had burned a pin save where it and the insulator were coated with alkali dust. They had operated through a drizzle with as many as 50 cracked insulators on the line. Pins were treated by placing in hard paraffine at 150° C. from 6 to 12 hours. The important part was that the pins were kept below the surface of the paraffine as it cooled. The paraffine would then be sucked clear into the center of the pin, probably due to condensation of the vapors in the pin. The heart of pins so treated will not absorb the slightest moisture after soaking as far as can be determined by delicate chemical balances. He took the position that if the insulator is made good enough so that it can be safely placed on an iron pin, it is good enough so that there is no danger of its burning a wooden pin. Later in the discussion he expressed the opinion that ultimately we will probably come to iron pins and steel towers, but for pioneer work such as is being done now with insulators having only a small factor of safety, they needed the help of the wood pin. Answering a question as to whether men were ever killed from contact with wooden poles, Mr. Nunn said that if a pole had become charred, the men had learned that it was wise to feel at the base of the pole first, gradually working up to test the potential existing on the pole. E. Kilburn Scott told of the necessity of using iron base poles in India because of the habit of white ants starting below the ground and eating out the inside of wood structures, leaving only the outside shell. A barb wire wound spirally around a pole is also sometimes necessary to keep the monkeys from climbing it.

A history of "The Work of the Telluride Power Company" was then read by P. N. Nunn, chief engineer of that company, who was introduced by Chairman Scott, making a few appropriate remarks about the pioneer work in high voltages done by this company for fourteen years, this being the first presentation of it before a technical society. Mr. Nunn's paper began with an account of the company's first 3,000-volt, single-phase transmission in 1890, followed by experiments on three different kinds of circuits in 1895 carried on for some time at 30,000 to 60,000 volts, during which time in the dry season 10,000 to 40,000 volts were carried on telephone insulators for about three months. These experiments gave the data upon which the first 40,000-volt line was built at Provo. This line had 76 inches between wires and pins, bringing the insulators 6 to 12 inches above the crossarms. The burning of crossarms at iron braces caused the adoption of the all-wood construction on later lines. The company now has 1,000 miles of transmission line in Utah, Montana and Colorado and some six power stations. Many interesting historical details were given in this paper that space does not permit to be mentioned here. At the request of Chairman Scott, Mr. Nunn added a few words about the provisions being made at the new Provo plant to train employes in high-voltage work and carry on researches on matters of value to the company.

The paper by L. M. Hancock on the "Bay Counties Transmission System," and the paper by R. F. Hayward, on "The Operation of Power Plants in Parallel," were read, and after a short discussion on the latter the section adjourned. (See E. W. and E., p. 476, Sept. 17.)

The paper which was to have been presented by R. D. Mershon on "The Maximum Distance to Which Power Can Be Economically Transmitted," was not ready for presentation, but was read by title and will probably appear in the Congress proceedings.

Mercury Vapor Lamps.

A batch of interesting patents was issued last week by the U. S. patent office on mercury vapor lamps to Mr. Peter Cooper Hewitt and two of the engineers associated with him in experiments and development, viz., Dr. Max von Recklinghausen and Mr. Percy H. Thomas. Some of the applications are of old date, and the features in each patent may therefore be deemed to have become part of the living art. Mr. Hewitt's two patents relate respectively to the use of radioactive materials with his lamp, in one instance his object being moreover to reduce the initial resistance to starting which appears around the negative electrode and in the other to claim the "method of starting a gas or vapor electric apparatus of the character described, which consists in creating by means located within the apparatus a radioactive effect, and applying to the terminals of the apparatus a condition of electrical potential adapted to operate the same." Dr. von Recklinghausen's invention consists in constructing the apparatus so as to obtain a more even distribution of the vapors of condensation, the major portion flowing back directly to the generating positive electrode while the excess is condensed in such a way as to flow back into all of the positive electrode receptacles and overflow finally into the negative electrode receptacle. Mr. Thomas' patents provide for the proper distribution of the material between the electrodes, taking advantage of the negative electrode flame; and also for the replenishing electrode waste. The drawings that accompany both patents show a device containing only two electrodes, both of which consist of vaporizable material such as mercury, and illustrate not only the proper distribution of the electrode materials, but the manner in which the negative electrode flame will discharge the mercury in small particles and thereby prevent the formation of threads or filaments of conducting material.

The Phipps Power Building, Pittsburg.

An interesting example of the "block system" for electric light and power is afforded by the Phipps Power Building which has recently been constructed and equipped at Pittsburg, and which is intended to serve as a private central station for a group of buildings closely adjacent to it on the property of the owner. The new Bessemer Building is one of the first to be thus served from the new plant, the engineering and architectural designing of which, as well as the superintendence of construction throughout, was in charge of Mr. Julian Kennedy, engineer, of Pittsburg. The plant was described this month before the Engineers' Society of Western Pennsylvania by Mr. Gerald E. Flanagan, to whom are due the details given below.

The building in which the power plant is housed is one hundred feet square and is ten stories in height, of heavy steel frame and brick curtain walls with Indiana limestone trimmings. It rests upon

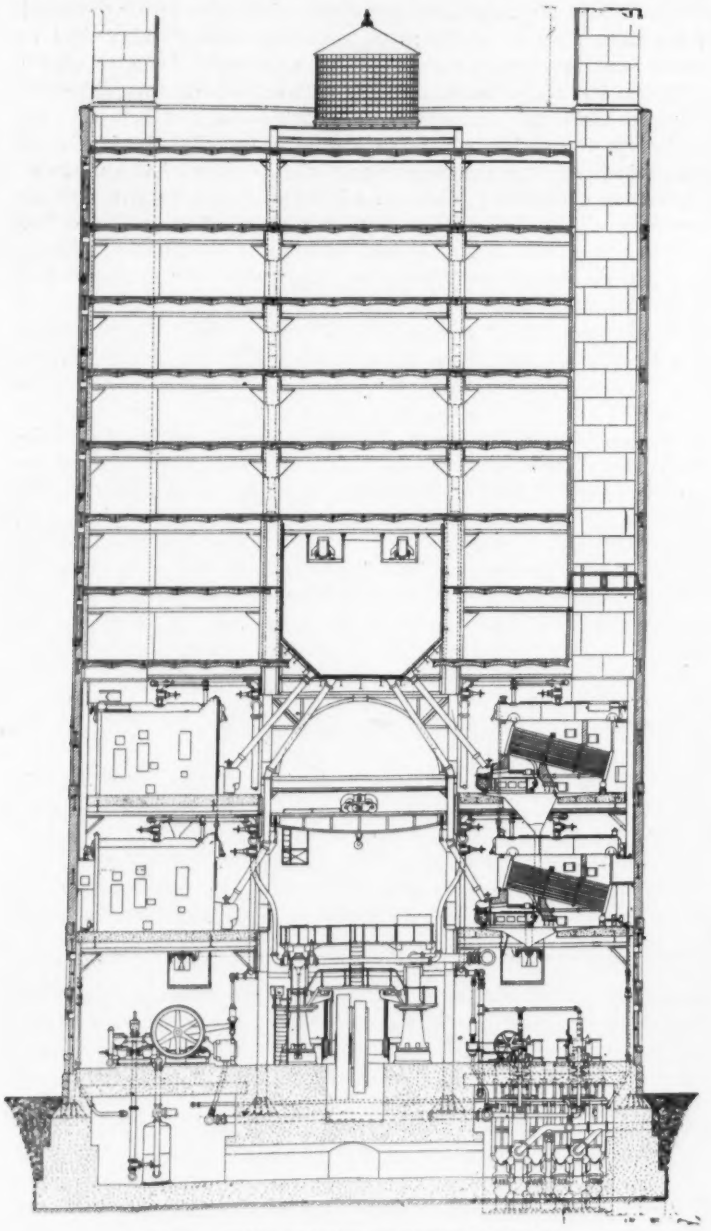


FIG. 1.—CROSS-SECTION OF POWER BUILDING.

a massive concrete foundation, which, in turn, is carried down to a solid footing upon a bed of gravel. It is built to the property line on Cecil Alley, but is located a distance of four feet from the adjoining property on the side toward Penn Avenue, while the other two sides face the property of the owner, and it is the intention to maintain a space of twelve feet between them and any buildings to be erected in the future; thus giving light and air on all four sides. There are large windows on all sides which are protected by rolling steel shutters. The machinery and boiler floors are formed of concrete, between the steel beams and over them, while throughout the rest of the building the steel is covered with hollow fireproofing tile, around the columns and arched between the floor beams. These floors are then surfaced with concrete over the fireproofing. In a similar manner, the roof beams are covered with fireproofing tile and concrete, then with heavy tar paper, and surfaced with Welsh tile. The first three stories are twenty-four feet from floor to floor, and are occupied entirely by boilers and machinery; the remainder are thirteen feet in height, and are suitable for light manufacturing; an ample supply of power in various forms being immediately available. There are two roomy passenger elevators, each of a capacity of three thousand pounds live load, and one large freight elevator of ten thousand pounds live load capacity. The stairway is entirely of iron and steel; the treads and landings being of cast-iron plates of diamond pattern. The first, or engine room, floor is nearly six feet above the sidewalk, being so located as to be safely above the highest recorded flood stage, making it about 33 feet 6 inches above pool stage of the Allegheny River, and the building is so constructed that even with the highest water there are no openings through which it can flow into the basement. As an additional safeguard, the generator foundations are so constructed that even if the basement was filled with water none of it could find access to these machines. The basement floor is 20 feet 6 inches below the engine room floor, and is formed of 4 feet of concrete over the entire surface placed directly upon the gravel. From this base rise the outer walls carrying the exterior columns, and in the center a mass of concrete forming foundations for the large engines and heavy interior columns supporting the coal bin and the boiler and manufacturing floors. This foundation is continuous from the front to the back wall, and divides the basement into two parts, except that it is pierced both lengthwise and transversely with large tunnels permitting free communication, and serving as conduits through which the necessary piping may be carried. The flooring over these side basements is constructed entirely free from the framework of the building. The second and third floors extend only along the sides of the building of sufficient width to carry the boilers, except that they connect by galleries at each end. The centre space is thus left open to the bottom of the coal bin, which occupies the centre of the fourth and fifth floors.

On the first floor, in the center, are the two large engines direct

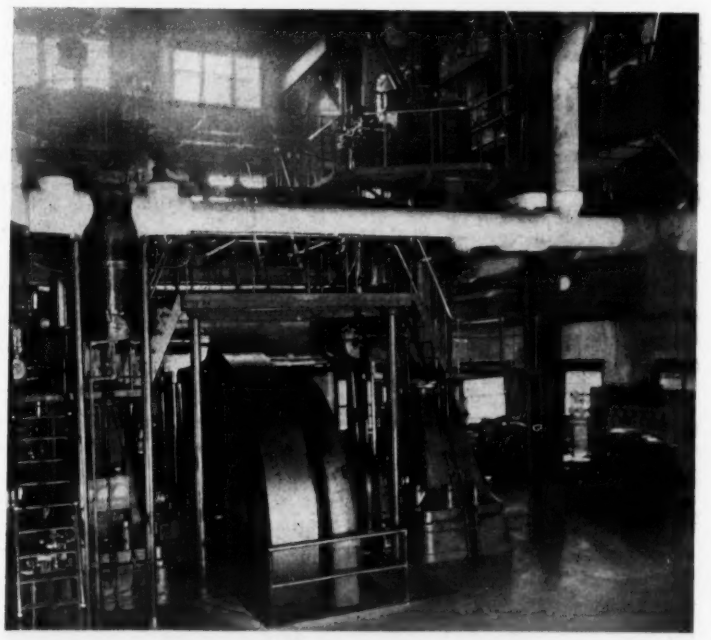


FIG. 2.—GENERAL VIEW OF ENGINE ROOM.

connected to alternating generators, with provision for installing a third unit. To the left of these are two elevator pressure pumps, also a place for a third when required. On the right are located two small engines direct connected to exciters. In this room is also located the switchboard, with ample space both in front and behind, giving free access to every part; the rear side is in strong daylight for its entire length.

At the rear of this room appears the steam end of the vertical pumps which draw the general water supply from the river, the base of these pumps being at a level of 6 feet 6 inches below the

basement floor; and beneath this level again is a small sump into which all leakage in the basement collects and is pumped into the river. The remainder of the basement is taken up by the boiler feed pumps, of which there are two in place with room for a third; feed water heater with space for a second one, softening apparatus for feed water, exhaust muffler and grease separator, return water tank and small receivers and pumps for various drains. In the basement on the other side of the building are located the accumulators, a large air tank for cushion on the return line to the elevator pumps, and a pump at the artesian well which supplies the drinking water. In a small intermediate basement in front of the engine foundations are located the filters for the boiler feed purifying system. On the second floor of the building are located the boilers, and the third floor is arranged so as to be finally used for the same purpose, thus doubling the present capacity. Above the level of the third floor boilers is the coal bin.

The engines are of the vertical type Westinghouse-Corliss cross compound with reheating receiver; the cylinders are 28 inches and 46 inches by 48 inches. Both the guides and the main bearings are water cooled. The fly-wheels are 19 feet in diameter, and weight about 200,000 pounds each.

These engines are direct connected to 1,000-kw, 3-phase, 60-cycle, rotary field Westinghouse generators; they are 80-pole machines, running at 90 revolutions.

Over the engines and generators is a 25-ton electric traveling crane, built by Pawling & Harnischfeger, and there is a sunken way in the engine room floor which permits the entry of wagons at the street level to a point commanded by the crane, thus facilitating the delivery or removal of machinery, etc. When not in use this space is covered by a movable floor. There are two Laidlaw Dunn Gordon special elevator pumping machines of the three-cylinder compound horizontal pattern, 21½-inch high pressure cylinders, and two 28-inch low-pressure cylinders, with reheating receivers; the plungers being 6¼-inch diameter, and the stroke 24 inches. These machines deliver water against a pressure of 850 pounds, the capacity being 700 gallons per minute. Water is supplied by two vertical tandem-compound duplex Wilson-Snyder pumps with cylinders 18 inches and 30 inches, 17¼-inch plungers by 30-inch stroke, which draw water from the Allegheny River and deliver it against a pressure of 150 pounds, to be used for all purposes except drinking, including fire service.

Two 12-inch by 12-inch Harrisburg engines are direct connected to 60-kw Westinghouse direct-current generators. These are used for exciting the fields of the large alternators, and for other purposes for which direct current may be required. If at any time the

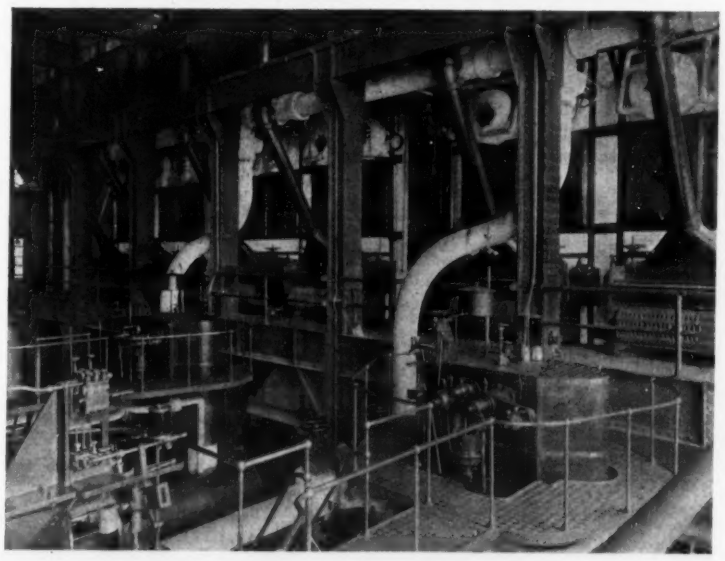


FIG. 3.—VIEW OF BOILERS, ETC., ABOVE THE ENGINES.

demand for direct current should exceed the capacity of these machines other units can be installed, or rotary transformers may be used. The boiler feed is furnished by two Wilson-Snyder compound duplex pumps with cylinders 8-inch and 14-inch on the steam end, and 7-inch water cylinders by 18-inch stroke. The elevators, both freight and passenger, were built by the Otis Elevator Company, and are of their most approved pattern of high-pressure machines, operating with 850 pounds hydraulic presure. They are supplied with all up-to-date devices for operating and for safety. The accumulators were also supplied by the Otis Company. They have plungers 12 inches in diameter by 12 feet stroke.

The switchboard is 7 feet 6 inches high and 30 feet 4 inches long. It has one panel for direct current, three for the alternating generators, and six distributing panels. It is of blue Vermont marble mounted upon an iron frame, and is equipped with all the instruments necessary for the control of large currents. The lead-covered cables from the generators to the switchboard are taken in

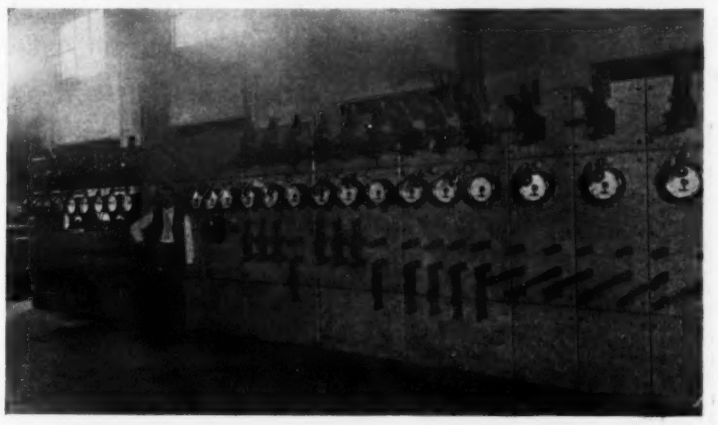


FIG. 4.—SWITCHBOARD.

conduits under the floor. These conduits are so covered that they are not visible, and cause no interruption to the continuity of the floor; but they can be opened without serious difficulty should occasion arise. The cables go from the board down through the floor to the basement, and thence through the tunnel to the Bessemer Building.

The Scaife system of treating tanks and filters is used for purifying the water before it enters the boilers. This apparatus consists of two solution tanks provided with small pumps for forcing the solutions in the precipitating tanks, of which there are also two. These latter are closed tanks, being required to withstand an internal pressure of two hundred pounds. Through these tanks the water travels very slowly, the bulk of the impurities settling to the bottom during its passage. From here the water goes to the filters, of which there are four, also of the closed tank pattern; the pressure, of course, being the same as in other parts of the feed-water system.

The feed-water heater is of the closed rectangular pattern made by the Pittsburg Heater Company. There is also an air compressor for supplying air to the cushions on the hydraulic system; and oil filters and pumps for the lubricating system. Coal is delivered at the two large receiving doors on Cecil Alley, and falls through heavy cast-iron gratings into hoppers beneath. From there it is raised by two elevators, designed by Heyl & Patterson, to belt conveyors which traverse the entire length of the coal bin. Moving trippers travel the full length of the conveyors and distribute the coal evenly along on both sides. The coal bin is of heavy steel plate stiffened with I beams; it is lined with cement plaster upon wire netting, the bottom being built into hopper forms from each pipe opening by hollow tile such as is used for fireproofing. Twelve pipes, each 12 inches in diameter, lead directly to the stokers at the boilers, and other openings are in the plates ready for the second floor of boilers.

The present installation consists of twelve boilers of the Babcock & Wilcox water tube type, aggregating 3,600 horse-power rated capacity. Each boiler consists of 140 4-inch by 18-foot water tubes, and two 36-inch by 18-foot drums. They are built two in each battery, and furnished with Babcock & Wilcox chain grate stoker, this construction giving free access to one side of each stoker. The furnace gases discharge directly in the rear of the boilers; those from each boiler into a separate vertical flue provided with a damper which swings open of its own weight, and is held in the desired position to check the flow of gases by a chain. The vertical flues are 15 inches by 10 feet, and rise directly to a 4-foot by 10-foot horizontal flue. They have expansion joints about the center of their length. Fig. 3 gives a general view of one of the batteries of boilers, showing coal chutes, chain-grate stokers, etc.

The horizontal flues each have two expansion joints, and are suspended from the girders above in such a manner as to admit of the requisite motion in the direction of their length. They are provided with numerous cleaning doors.

There are separate stacks for the boilers on each side of the building. The stack proper rests upon heavy girders, but between it and the horizontal flue is a short section or sub-base which connects to the stack through an expansion joint. This sub-base rests directly over an opening in the upper side of the horizontal flue, and is also joined to it by a large connecting flue at an angle of about 45 degrees to provide a free sweep for the gases as they change from a horizontal to a vertical direction.

The stack is 11 feet inside diameter, and rises to a height of 200 feet above the grate bars. It is built of 3/8-inch steel plates,

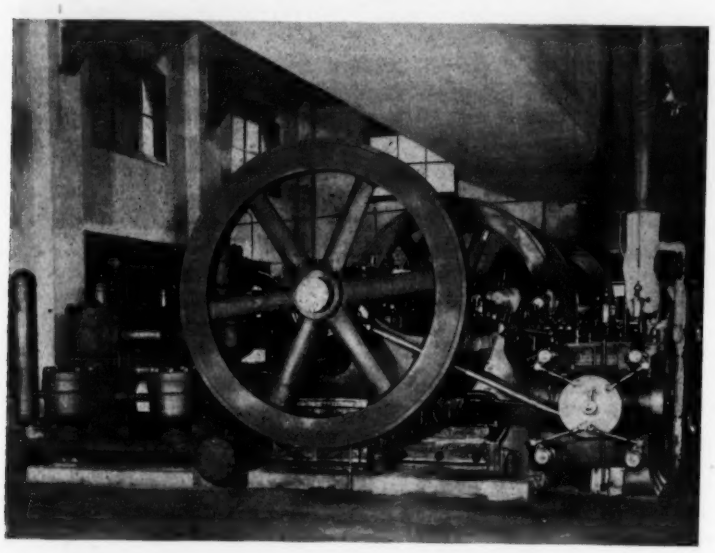


FIG. 5.—PUMPS.

except the bottom ring and the rings where it is stayed to the building at the roof, which are ½-inch. There are four substantial brackets at the base which rest upon the steel work of the building, and the top is stiffened by a ring made of two 6-inch by 6-inch by 7/8-inch angles, and below this a ring made of Z bar for carrying slings for painting. A ladder extends from the roof to the top of the stack. The stacks are not lined. Around the 11-foot stacks are tile wall inclosures 13 feet square, permitting the intervening spaces to serve as ventilating shafts for the engine and boiler floors. The stacks rising from the roof are partially shown in Fig. 1.

With the exception of the high pressure hydraulic lines all valves and pipe fittings of a given size in this building are interchangeable, from the smallest size up to fourteen inches, this being the largest size used for any purpose other than exhaust steam and a few fittings directly connected to the main supply pumps. At these pumps there are some 16-inch valves and a number of special 16-inch fittings. For exhaust steam there are valves and fittings 18 inches, 20 inches, 24 inches and 30 inches. The result is that any valve or fitting can be used in any part of the plant provided it is the proper size. Aside from the hydraulic lines, all valves and fittings are plain faced, the flanges above 6 inches being rolled steel, the fittings cast iron.

The flanges and fittings on the hydraulic lines are of a type especially designed for this plant. The flanges are screwed to the pipe, and are then turned in the lathe in such a manner as to leave the pipe and a portion of the flange immediately surrounding it projecting a considerable distance from the face. This projecting portion is slightly curved on its face, the highest part occurring on the pipe itself, and between these pipe ends the heavy copper gasket is compressed. It will be seen that there are no male and female joints in this system; all flanges of a given size are alike, a corresponding projection being formed upon the fitting. All the fittings are steel castings, the flanges being of forged steel. The elbows are of long sweep pattern and the tees are strengthened with heavy ribs. In order that the gasket may center itself readily, its outside diameter is made equal to the inside diameter of the bolt circle. A few of the bolts are put in place and the gasket slipped in between the flanges, the remainder of the bolts are then inserted and the joint tightened.

German Electrical Exhibits at the World's Fair.—IV.

By FRANZ WELZ.

THE instruments of the third section of the Siemens & Halske exhibit, which are all mounted on one switchboard as shown in Fig. 19, form a very fine collection of this firm's recording instruments, and commercial measuring instruments of different types with their accessories. The former instruments are built for recording of current, voltage and power on a continuous strip of

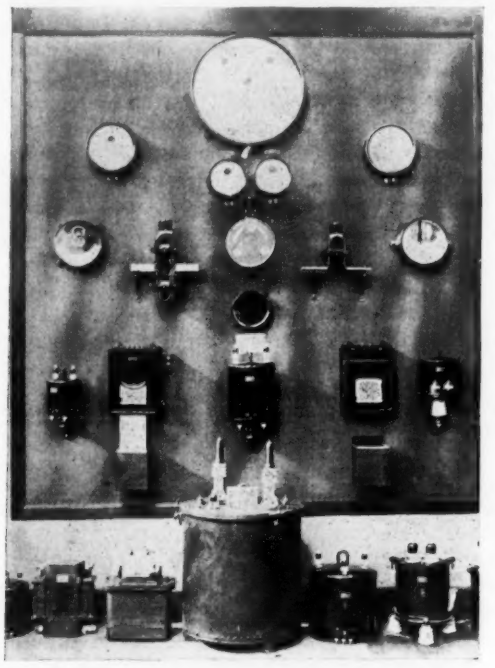


FIG. 19.—SIEMENS & HALSKE METERS FOR COMMERCIAL USE.

paper, and their features do not involve any prominent new ideas. For registering in high tension installations and for very heavy alternating currents, current and potential transformers are used in connection with these instruments. The potential transformers, which are built as high as 30,000 volts, are shown at the bottom of the illustration, while the current transformers appear in the middle, their detailed construction being shown in Fig. 20. The plane of winding of the secondary coil is at right angles to the primary current loop and this transformer gives results independent of fre-

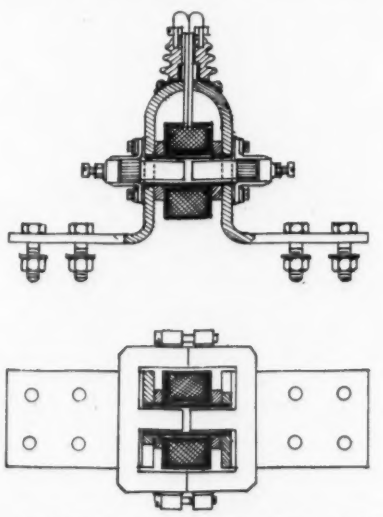


FIG. 20.—SIEMENS & HALSKE CURRENT TRANSFORMER.

quency, and uninfluenced by neighboring currents. A new departure in the field of recording instruments is the recently manufactured apparatus of Siemens & Halske, whereby a spark punctures the paper recording the momentary value of current, voltage, etc. These instruments are specially useful in cases where a sudden rise of current occurs, as for instance, in tests on electric cars, cranes and so forth. The instruments possess a very quick and nearly aperiodic

moving system, so that the position of the needle really corresponds at any moment to the instantaneous value of the current, voltage, etc. Instruments of this kind are built as direct current apparatus for registering current, voltage and power; for single and three-phase alternating current for the measurement of power only. The measuring instruments on this switchboard are intended principally for alternating current and are constructed according to the Ferraris principles. Their main advantages are the large torque of the movable system, and therefore reliable readings, unchangeable zero, excellent damping even for instruments with long pointers. A clear, and if desired, nearly uniform scale of 120 degrees gives great accuracy in the readings, and finally these instruments are not influenced by stray magnetic fields. At the top of the switchboard, as seen in Fig. 19, there is a universal measuring instrument combining an ammeter, voltmeter and wattmeter in one case. There can be no objection to this arrangement as the three instruments do not disturb each other. It gives, however, a very compact apparatus which makes it possible, by a mere glance, to get an idea of the electrical conditions in the circuit. The wattmeter and the ammeter are connected to the same current transformer, and the wattmeter and voltmeter to the same potential transformer. The instrument possesses only three binding posts, two for the current and one for the voltage. The Ferraris voltmeter, seen at the right below the latter instrument, is distinguished by a nearly uniform scale brought about by a patent spring arrangement. In the middle of the switchboard is seen an automatic voltage regulator built for single or three-phase installations according to the familiar principle of the rotating field. The instrument actuates either a ratchet device or an electromagnetic coupling whereby the regulation of the voltage is produced. In the middle of the switchboard below the universal measuring instrument is mounted a phase indicator with two voltmeters and a case containing the phase lamps. One of the voltmeters indicates the voltage at the terminals of the machines; the case contains three incandescent lamps connected in such a way that they are lighted up successively; the direction in which the lighting occurs, enables the switchboard attendant to know whether the prime mover is running too fast or too slow, and the instrument is marked accordingly. The other voltmeter is connected in parallel with one of the lamps and shows more accurately than the lamps the moment of being in phase.

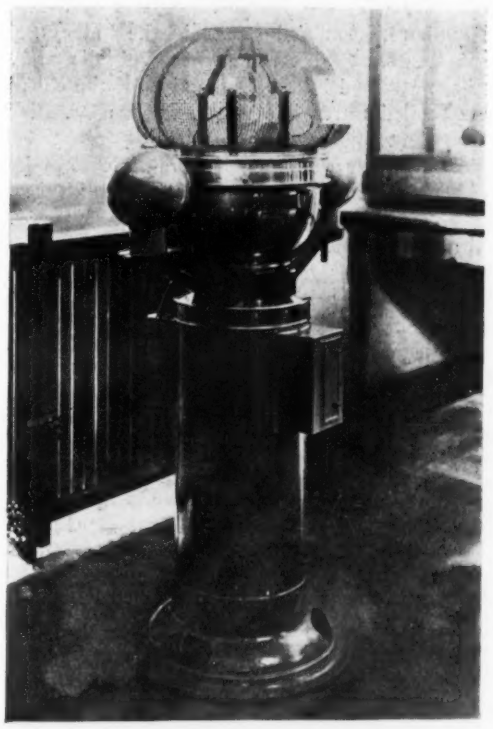


FIG. 21.—SENDING COMPASS FOR TRANSMISSION OF COMPASS NEEDLE MOVEMENT. SIEMENS & HALSKE EXHIBIT.

The last section of the Siemens & Halske exhibit for scientific instruments consists of a complete equipment for transmission of the position of the compass needle on modern warships. This equipment is essentially made up of a sending compass (Fig. 21) and a receiving compass. The sending compass is installed in a magnetically favorable location of the ship, where there is the least disturbance of the earth's magnetic field from the big iron and steel masses of the modern men-of-war. Some of these masses, being movable, are likely to change the direction of the earth's magnetic field. The ordinary compass in use in the German navy is employed, but the dial is the so-called "Kaiser-dial," which is specially fitted for this purpose, on account of the chain of small magnets placed on the periphery. Connected with the dial is a plate of mica which is covered with a coating of tin foil. A horn-shaped section of this coating is cut out and the rays of a powerful incandescent lamp, 6.8 amperes at 75 volts, placed above the movable dial, are thrown upon a stationary bolometric device below the dial. The bolometric device is arranged radially in the form of a lattice and according to the respective positions of the dial, different parts of it are struck by the light of the incandescent lamp. By the change in the exposure of different parts to the light changes of resistance are brought about, which are followed by changes of the strength of current in the set of stationary resistances connected to the lattice. These changes in the strength of the current cause the dial of the secondary compass to follow the movement of the sending compass.

The electromagnet of the receiving compass and the incandescent lamp and bolometric device of the primary compass, are connected to the main switchboard, whence they are fed with direct current. The variations in the voltage of the installation do not affect the efficiency of the transmission. The secondary compass consists principally of a measuring instrument of the Deprez-d'Arsonval type with a horseshoe electromagnet. The movable system consists of two differentially wound coils through which flow currents varying in intensity according to the changes in resistances in the bolometric arrangement of the primary compass. Attached to this movable coil is the dial of the secondary compass. By a special device it is made possible for the dial to execute one whole revolution without injuring the spirals leading to the movable coil. Two forms of this secondary compass are on exhibition, a smaller and a larger size. This system of transmission of the movement of the compass needle has some marked advantages. When the current is thrown on, the receiving compass indicates at once the direction of the sending compass and no special adjustment is necessary. The movable part of the secondary compass possesses excellent damping, which causes the position of the secondary dial to correspond at any moment to that of the primary compass, the secondary dial following the movement of the primary dial continuously and not in a stepwise manner. The primary dial can swing entirely free, there being no hindrance to its movement from contacts. With half the strength of the directing force it will work with sufficient certainty. If the apparatus is once adjusted no readjustment is necessary for long periods of time, and several sets of the apparatus have been in practical service for several months without losing their accuracy. There are no relays nor parts which are subjected to wear and tear which could influence unfavorably the transmission of the movement. The incandescent lamp above the bolometric device can be replaced without causing any error. Such a transmission system in which the sending compass can actuate simultaneously a number of receiving compasses, was installed some years ago upon several ships of the Holland navy, and the results obtained were very satisfactory, in spite of the fact that this was the first set of this apparatus ever built. Since that time the system has been considerably improved as to its fitness for navy work, and the apparatus recently installed upon ships of the German navy has given excellent results under the most severe conditions.

Finally, the Siemens & Halske Co. contribute very largely to the exhibits in the electro-therapeutic section. The Roentgen cabinet, equipped by this firm with its latest types of induction coils and Roentgen apparatus, is of the highest interest for the physician and everyone acquainted with this line of work. A very imposing view, as shown by Fig. 22, is given by the seven induction coils arranged upon steps in the centre of the cabinet, beginning at the bottom, with an inductor giving a 40-inch spark and ending at the top with one of 10-inch spark. The construction of these induction coils, of which the celebrated German scientist, Ruhmkorff, first worked out the principles, has been improved so greatly by the Siemens & Halske Co. by long experience and numerous thorough tests that a breakdown of the coil is almost impossible even under the most severe conditions of service. The confidence of this firm in its apparatus is best manifested by the fact that it has not been deemed necessary to make the hard rubber tube which surrounds the pri-

mary coil, removable. A special kind of material is being employed for the insulation of the secondary coil of a sort which never gets entirely hard and can therefore withstand the greatest variations of temperature without becoming cracked. Every one of the coils making up the secondary is subjected to a careful drying process in vacuo. The primary core is composed of thin iron sheets such as are used in the construction of dynamos and the experience gained in the building of transformers has found a useful application in this case. The 40-inch inductor is connected up, and demonstrations and lectures on all the apparatus are given every day at three o'clock. For an interrupter this firm uses at its exhibit the well-known

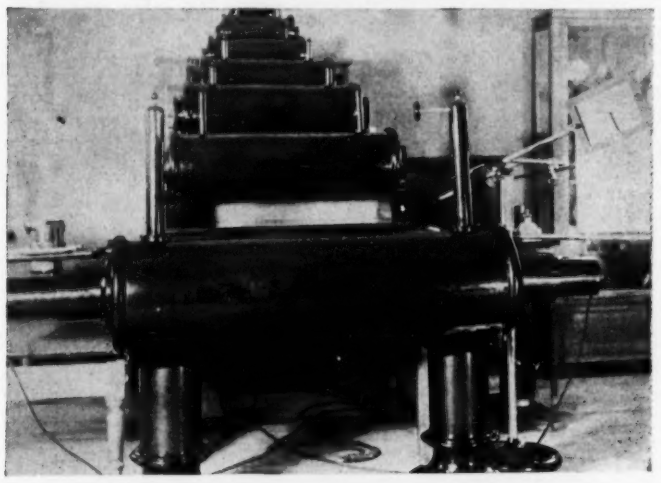


FIG. 22.—SIEMENS & HALSKE INDUCTION COILS.

Wehnelt type, of which several are in service. The Siemens & Halske Co. builds all the other interrupters, but uses by preference the Wehnelt. This interrupter is far simpler than the others, as its use does away with the condenser and the driving motor, it can be worked with entire safety up to the highest capacities and greatly facilitates the regulation of the spark; besides, this interrupter has the advantage that it can be operated for months without attention. All the troubles which occurred when electrolytic interrupters were first applied to X-ray work have been entirely overcome; on the one hand by improvements in the interrupter and induction coils,

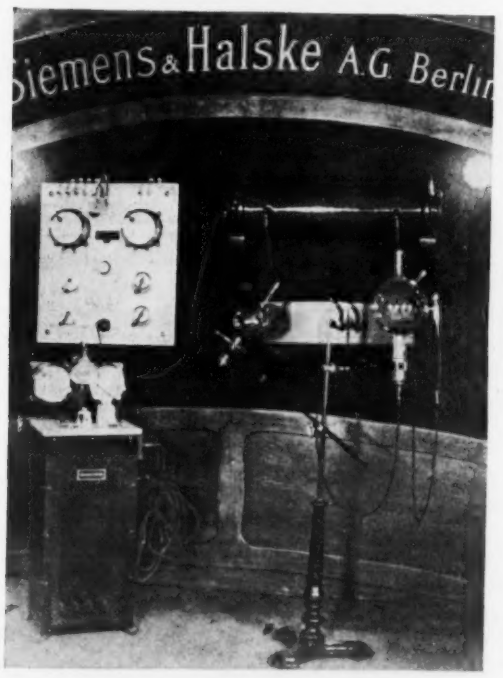


FIG. 23.—SIEMENS & HALSKE EQUIPMENT FOR X-RAY WORK.

and on the other by perfecting the Roentgen tubes. The electrolytic interrupters are at the present time the best apparatus of this kind. In this connection the subdividing of the winding of the primary coil was of great importance as this gave the possibility of selecting for each tube the most appropriate length of the spark at sufficient intensity. The Wehnelt interrupter itself is built with a variable number of platinum pins which make the operator independent of the permanent regulation of the interrupter. The complete equipment for Roentgen work is shown in Fig. 23. This outfit is daily used for the demonstrations. A Wehnelt interrupter with three platinum pins is used for this 20-inch coil. So simple an arrangement does not require a skilled operator, as the closing of a few switches is sufficient to place the tube in operation. The connections are arranged in the manner indicated by Dr. Walter. At the left of the main switchboard in Fig. 23 is seen a small switchboard containing all the necessary apparatus for work with Roentgen tubes. At the right of the figure is shown a so-called orthodiagraph, an apparatus which serves in connection with Roentgen tubes for determining the exact size of the heart and for locating foreign bodies. A pencil moving parallel to the focus of the X-ray tube serves for following the contours thrown by the tube on the fluorescent screen. Besides the above the Roentgen cabinet contains another apparatus, a so-called "compression diaphragm tube," which has become indispensable for making good Roentgen photographs. As is proven by photographs on exhibition by Dr. Albers-Schoenberg, Hamburg, this apparatus enables the operating physician to make a sharp and contrasting radiograph and especially to picture with great accuracy the most inaccessible parts of the body, as for instance the lumbar region and stones in the kidneys. Very great success in the treatment of cancer, lupus vulgaris and other skin diseases has been attained by the application of the chemical rays in the arc—the so-called ultra-violet rays. It was Dr. Finsen, of Copenhagen who first discovered the healing properties of these rays. In order to obtain a surplus of ultra-violet rays from the arc, iron was used instead of the ordinary carbon and very satisfactory results were obtained with these lamps. The Siemens & Halske Co. is exhibiting two sizes of these lamps, one for 6 amperes and the other for 25 amperes. The arc is formed between two iron balls and the lamp is distinguished by its great simplicity which guarantees reliable working. The above description certainly proves how fully the Siemens & Halske Co. covers with its products the whole field of application of electricity; but it may be mentioned that this firm has contributed in addition to all the above the largest part of the electrical equipment of the "German outdoor railroad exhibit." There we see in daily operation the latest type of the Siemens & Halske block signal system as it is employed for the state railways in Germany. Of this a full description will be given in a succeeding article.

A Trolley Parallel for Steam Railroad.

Reports are afloat in Connecticut and in New York towns along the Sound that the United Gas Improvement Company of Philadelphia, through Francis A. Stratton, vice-president of the Westchester Lighting Company, is again negotiating for the New York & Stamford trolley system, a $1,600,000 corporation which operates a line from Stamford to Larchmont, with branches to all the shore resorts in Westchester County. Mr. Stratton had an option on the line some time since, which was allowed to lapse, and the resumption of the negotiations at this time promises interesting developments in the suburban trolley field. It is understood that the plan behind the proposed purchase of the New York & Stamford road contemplates the construction of a line from Larchmont into Bronx Park, New York, to connect with the Interborough Rapid Transit Company's line there and afford virtually a through passage from New York City to all points along the Sound within the limits of trolley travel.

In conjunction with the proposed connection with the Interborough, however, it is recalled that the New York, New Haven & Hartford road in announcing its $7,000,000 improvement not long ago, stated that its trains would be the ones to have official connection with the lines of the Interborough at Bronx Park. The construction of a through paralleling line by the New York & Stamford people would produce virtually the same situation that the United Gas Improvement Company effected in Connecticut. There it built up on the basis of the Bridgeport trolley lines a system that threatened seriously the monopoly which the Consolidated road had had on Connecticut traffic since time out of mind, and which resulted first, in the electrification of a number of the suburban lines of the New York & New Haven around Bridgeport and New Haven, and eventually in the purchase through a new holding company, at profitable prices, of a number of the roads which cut into the railroad's preserves most seriously.

Suction Gas Producers.

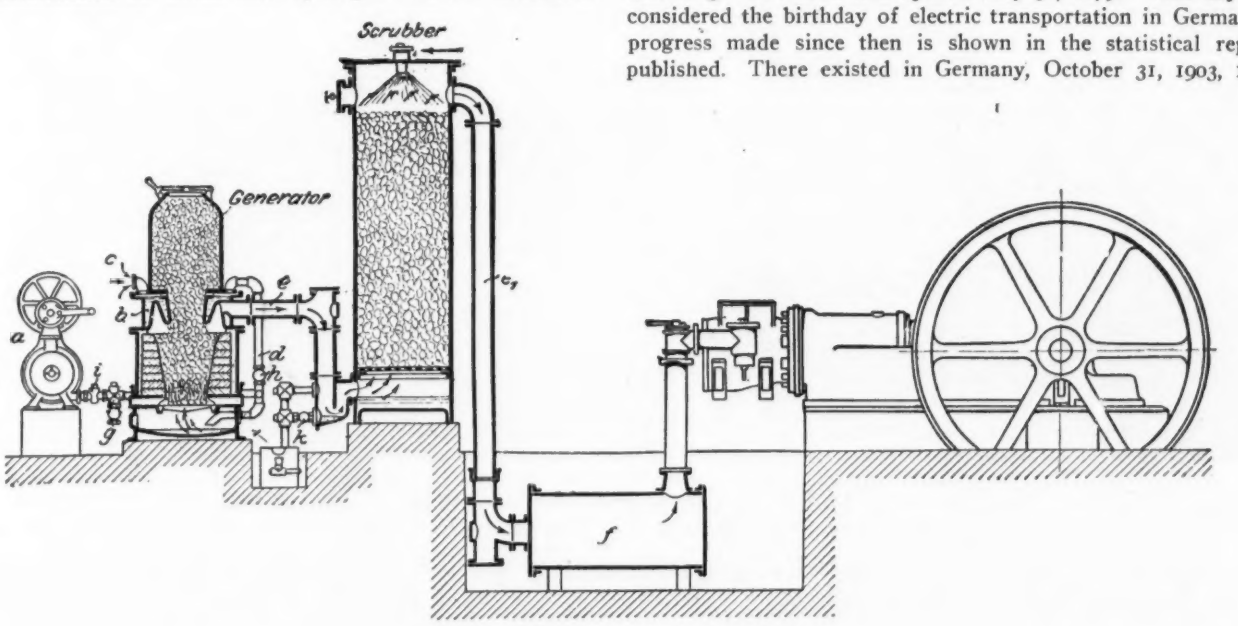
BY OSKAR NAGEL.

Producer gas power plants are built for generating out of a suitable fuel a mixture of carbon-monoxide and hydrogen which, if used in gas engines, allows an exceedingly advantageous utilization of the fuel. Up to the present time, producer gas has been produced in so-called pressure gas producers by evaporating water in a separate boiler and by leading the steam, mixed with air, by means of a steam jet blower or fan through the glowing fuel, whereby the steam is decomposed to hydrogen and the coal burned to carbon-monoxide. This mixture of combustible gases is led through a scrubber to a gas-holder and from there to the engine. It is evident from this description that for generating gas by this method a boiler and a gas-holder are required, which increases considerably the cost of construction and of attendance. These pressure gas plants are now being rivalled by the so-called suction gas producer plants, which are much simpler and cheaper in construction and easy to attend, as no boiler or gas-holder is required.

In a suction gas producer plant the boiler is supplanted by an evaporator which, in small plants, is built on the top of the producer, and in large plants right near the producer in the form of a tubular evaporator. This evaporator generates the steam required by utilizing the heat of the producer and of the gases. This is of considerable advantage as compared with the old system, as the firing of a separate boiler is dispensed with, and the heat of the gases produced is used for generating the necessary amount of steam.

The heat of the gases respectively of the producer is entirely sufficient for furnishing such a quantity of steam as is required for the generation of an effective power-gas. The utilization of the fuel in suction gas producers is much higher than in pressure producers and reaches 80 per cent. or more. By leading the steam under the grate the latter is kept cool and clean.

The transformation of steam into hydrogen and the formation of carbon-monoxide takes place so quickly that the producer is always making the amount of gas required, and is able to start suddenly from a low to a full load.



ELEVATION OF SUCTION GAS PRODUCER.

A complete suction gas producer plant consists of a producer, an evaporator, an over-flow water-pot, a scrubber and an equalizer (sawdust scrubber). The producer is lined with fire-bricks. By the sucking action of the engine a mixture of air and steam is drawn through the burning fuel, whereby the producer gas is generated. There is always only as much gas made as is required by the engine.

The producer is provided with a hopper through which fuel can be filled into the producer without interfering with the working of the engine. The cleaning of the grate may be performed during the regular work.

The gas leaving the producer is heating up the evaporator and causes here a formation of steam which goes under the grate together with the necessary amount of air. From the producer the gas goes through the scrubber, in which it is cooled and purified from the dust and tar. From the scrubber it goes through a small equalizer.

Before starting the engine, the fuel in the producer has to be heated up by means of a small hand blower "a" until the gas is burning well. For this about ten minutes are required. When this point is reached, the hand blower is stopped and the engine started in the usual way. The engine is now drawing, by her own sucking action, the necessary amount of air, and producing her own power-gas. The air entering at "c" goes through the evaporator "b." Here it is saturated with steam, and the mixture of air and steam now goes through "d" under the grate of the producer, through the fuel, and then through the pipe "e" to the scrubber; from here through pipe "e-i" to the equalizing tank "f," which is directly connected with the engine. The gas-making process continues as long as the engine is moving, but as soon as the engine is stopped the gas making stops.

Anthracite, charcoal or coke can be used equally well for generating gas. It will take, according to the ash content, 1 to 1 1-3 pounds of anthracite or charcoal or 1 1-3 to 1 1-2 pounds of coke for developing 1 hp hour. With anthracite (pea) at $5.00 per ton 1 hp for 24 hours will cost from 6 to 8 cents. This is about one-sixth the cost of illuminating gas (at a price of 75 cents per 1,000 cubic feet of illuminating gas), or two-thirds the cost of natural gas power (at a price of 25 cents per 1,000 cubic feet of natural gas. These plants are built in units from 5 to 300 hp.

Anniversary of Electric Traction in Germany.

The Frankfurter Zeitung calls attention to the fact that German electric roads celebrate their twenty-fifth anniversary this year. In 1879, at the Berlin trade exhibition, Siemens & Halske, of Berlin, operated the first electric locomotive on a circular track about 1,000 feet long. The road was opened May 31, 1879. That day must be considered the birthday of electric transportation in Germany. The progress made since then is shown in the statistical report just published. There existed in Germany, October 31, 1903, 134 main centers (cities or districts) for electric roads, against 42, August 1, 1896. The total mileage in 1903 was 2,308 miles, the total length of single track being 3,438 miles. The number of motor cars was 8,702, of trailers 6,190. Almost everywhere the trolley system prevails. Dresden has still the mixed system—trolley and accumulators. In Berlin, Dresden and Düsseldorf some lines have underground traction. Only in the Palatinate and on a line at Bremerhaven the accumulator system prevails. It is expected, however, that these lines will soon do away with accumulators. On the street railways electricity is almost universal, only 33 miles, or about 2 per cent., being still operated by horses.

The substitution of electricity for steam on the branch railroads made little progress last year, only about 5 per cent. of these branches having been converted into electric roads, although it is expected that on account of the favorable results thus far attained more changes will follow.

Internal Combustion Engines at the St. Louis Exposition.

Constituting the only exhibit of considerable size of the kind at the St. Louis Exposition, the Westinghouse gas engines operating in the joint Westinghouse exhibit in Machinery Hall are of great interest. As in the case of the steam turbine exhibited, engines of moderate size have been selected as offering greater facility for inspection by visitors than larger units. Two types of gas engines are on view: the vertical single-acting and the horizontal double-acting. Both are multi-cylinder machines, the former having three cylinders with cranks at 120 degrees angularity, and the latter two cylinders arranged in tandem with single crank. Both engines are connected to engine type generators and are continually maintained in operating condition, generating, when required, part of the current necessary for operating the exhibits of the various Westinghouse companies in the Palaces of Machinery, Electricity and Transportation. The engines are piped to the city illuminating gas supply, and although they will be operated for short periods under all conditions of load for purposes of demonstration, it is not contemplated to make long continuous runs on account of the uncommercially high cost of the illuminating gas which is alone available on the Exposition grounds. As the steam turbine in the Westinghouse exhibit is operated continuously, it will be depended upon to carry the normal load. The two gas engine units represent, nevertheless, an equipment complete in every respect and adapted for the use of gas fuel and to deliver electric current for the usual purposes.

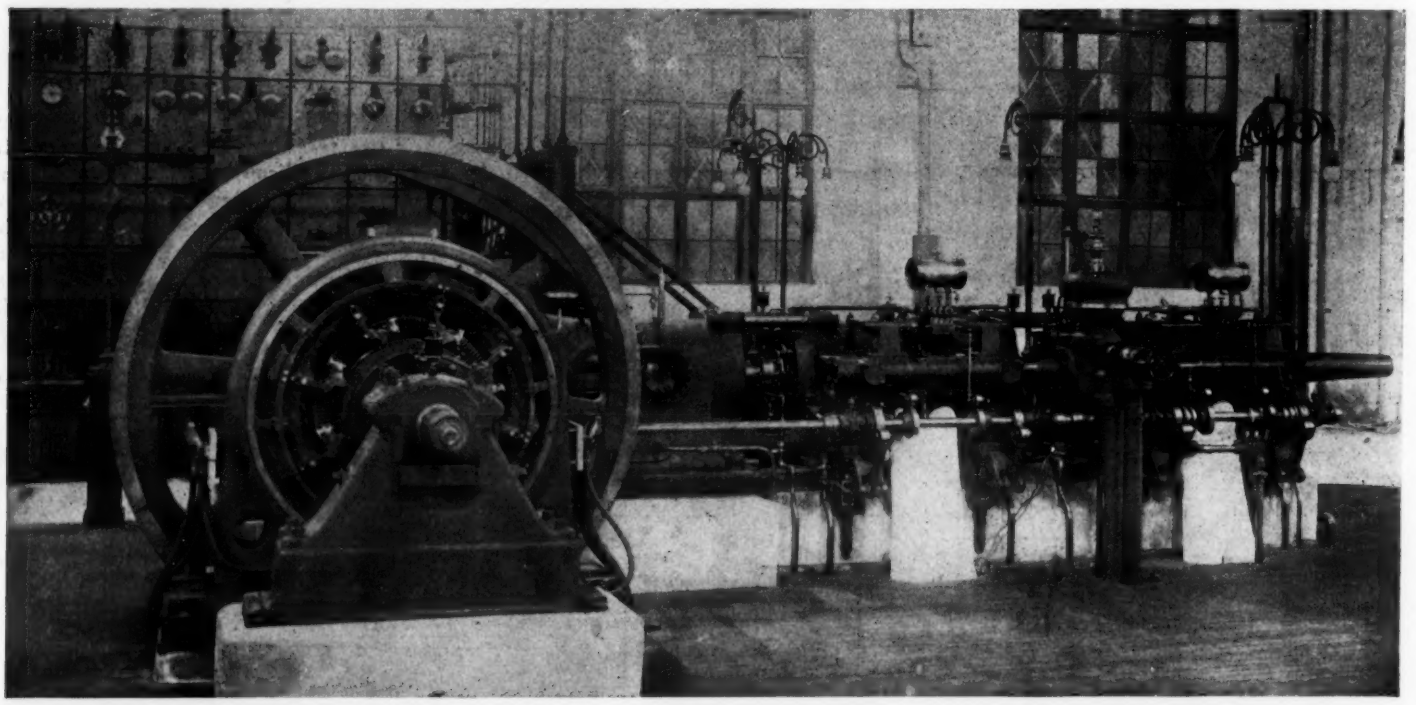


FIG. 1.—225-HP WESTINGHOUSE HORIZONTAL GAS ENGINE DIRECT CONNECTED TO DIRECT-CURRENT GENERATOR, MACHINERY HALL. PHOTOGRAPHED AT NIGHT BY AID OF COOPER HEWITT VAPOR LAMP.

As the double-acting engine is of somewhat more recent introduction than the longer established single-acting type, a brief description of its most important features may be of interest. General data regarding this unit are given below: Diameter of cylinders, 14½ inches; diameter of shaft, 9¾ inches maximum; diameter of shaft at bearings, 7½ inches; length of stroke, 22 inches; number of revolutions per minute, 200; length of unit over all, 27 feet 4½ inches, including fly-wheel; width over all, 7 feet engine, 13.3 feet unit; height over all, 8 feet 2 inches, including fly-wheel; fly-wheel diameter, 8 feet 9 inches; rated capacity, 200 B. H. P.; ratio of crank to connecting rod, 1 to 5.45.

Generator: engine type; number of poles, 8; voltage, 125 to 250, three-wire balanced system; rated capacity, 100 kilowatts.

The engine consists essentially of two water jacketed double-acting cylinders arranged in tandem with distance pieces providing space for access to the packing boxes between cylinders. Distance pieces are also used between the forward cylinder and crosshead guide for a similar purpose. The forward part of the engine—the frame—comprises the housing for the crosshead guide, two main bearings and a bed plate; the two cylinders and all the valve mechanism is supported by a bed plate extension bolted to the bed of the engine frame, both of which are grouted with concrete to the foundation. Cast-iron exhaust pipes convey the burnt gases through the floor to a 6-inch exhaust main leading to the atmosphere. Cooling water inlet and return pipes and gas and air supply pipes rise through the floor, thus removing complex and unsightly piping as far as possible from the engine room floor. A fly-wheel of moderate weight is provided with an outboard bearing pedestal, the generator in this case being of the engine type and mounted upon a separate concrete pier rising from the common foundation.

A noticeable feature of the general design of the engine is its resemblance to a modern high-speed tandem compound steam engine, and in fact, the experience of its builders in steam engine work has been largely brought into service in the design of the gas engine. This resemblance is particularly noticeable in the case of the main engine frame, shaft and cranks, fly-wheels, bearings, connecting rods, and arrangement of generator with outboard bearing. A more generous proportioning of parts has, of course, been necessary to accommodate the increased pressures resulting from the rapid combustion of highly compressed gases. The Beau de Rochas, or four-stroke cycle, is exclusively employed in this, as well as the single-acting type of engine. It involves the well-known features of positive scavenging and efficient combustion which are considered to be of the greatest importance in modern gas engine work, as would seem to be evidenced by the popularity of this cycle among the important American and European gas engine builders.

An important source of economy lies in the method of controlling the combustible mixture. As the quality of gas does not ordinarily vary widely, a most efficient proportion, once obtained, enables the engine to operate thereafter with maximum economy, since the governing is then very effectively accomplished by varying the quantity of mixture admitted to the engine according to the load to be carried. As the mixture is always of constant quality and as positive scavenging prevents it from becoming vitiated on its admission to the cylinder, the maximum duty per unit of gas is secured. That this method is the most favorable to high economy is well indicated by the fact that a number of prominent European builders, including the Deutz, Cockerill and Nuernberg Companies, have practically abandoned the variable for the constant method of mixture governing.

The detailed construction of the engine embodies in modified form the essential features which have contributed to the success of the Westinghouse vertical single-acting gas engine. In some respects it presents a departure from the widely accepted European gas engine practice. Considering the various parts in detail:

Shaft.—The shaft is constructed of open-hearth forged steel built up with two cylindrical crank discs, 30 inches in diameter, presenting a smooth exterior face, but cored out in the rear with suitable pockets for counterbalancing with lead. Proper speed of rotation is communicated to the cam shaft by a spiral gear split in halves and secured to the shaft close to the engine frame by key and bolts. The lay or cam shaft which extends along the entire length of the engine and at 90 degrees to the main shaft is thus positively driven at one-half the speed of the engine, this relation being necessary to obtain the proper valve movement in a four-cycle engine.

Journals.—In the main bearings a four-part, or quarter-box, arrangement is used, the bearings being adjustable horizontally by wedges set up by bolts extending through the caps. The upper quarter of the bearing and the cap are cast integral, the latter being provided with lips which overhang the vertical sides of the bearing, thus contributing greatly to its rigidity. In the outboard pedestal a two-part bearing is used, the lower shell of which is adjusted vertically by a wedge. As the pedestal itself rests upon a sole plate, horizontal adjustment is secured by wedges engaging its foot of the pedestal.

Crosshead and Connecting Rod are typical of modern steam engine construction. The former has removable babbitted shoes overlapping the ends of the crosshead and adjustable by wedges. These shoes are bored and turned about a common centre so that by slacking off the wedges the shoe may be slid out of position without disturbing the adjustment of the remaining parts. Both ends of the connecting rod have split bronze boxes and are adjustable by means of wedges, the crosshead end being of the solid and the crank end of the strap type.

Cylinders.—A striking feature of the cylinder construction is that the cylinder, combustion chamber, ignition and exhaust ports, together with the water jackets for the respective parts, are made in one casting. In order to reduce the strains in the metal of the jacket while cooling, the jacket wall is split around the periphery, the opening being closed by a steel tension band and a strip of rubber packing. Suitable hand holes are provided at various points in the water jackets for examining the interior, and to remove sediment which might be precipitated in case very dirty water were used in the jackets. The cylinder heads are of ample length to accommodate the packing gland and to provide for adequate water cooling passages. The heads are slightly tapered where they enter the cylinder bore, and starting screws are provided around the flanges so as to facilitate the removal of the heads.

Piston Valves.—The combustion chamber is approximately circular in horizontal section and is closed by the admission valve above and the exhaust valve below. Both valves are of the single-beat poppet, or mushroom type, and seat vertically along the same axis but in opposite directions, the admission valve opening downward and the exhaust upward. In the case of the admission valve, a separate bonnet is employed which, together with the valve, may be readily removed without dismantling any parts of the engine other than the tappet lever, through which cam motion is imparted to the valve. Both admission and exhaust valves are of steel and are held to their seats by spiral springs. The exhaust valve alone is water cooled. It is bored hollow throughout its length. This bore conveys cooling water to the head of the valves, this water returning in the opposite direction through an inner concentric tube, finally emerging at the lower end. Flexible rubber tubes convey the water to and from the opening provided. It is finally turned into the jackets. By spraying a small part of the jacket water into the exhaust pipes, the temperature of the pipe may be kept at a comfortable point through the absorption of the latent heat of evaporation of the water used.

Pistons.—Both pistons and the piston rod are water cooled as well as other parts subjected to internal heat. The piston rod is of high grade steel ground to a diameter of 4½ inches throughout its length. An effective means of introducing the cooling water is secured by a telescopic pipe connection bolted to the inside of the crosshead guide. The inner tube of this telescopic joint is attached to the crosshead at such a point as to convey the cooling water to the end of the piston rod bore, whence it proceeds in succession through the two pistons, emerging through a bronze tail rod extending through the rear cylinder head. Each piston is a one-piece casting, cored hollow to accommodate the circulating water, and packed by numerous cast-iron packing rings set out with flat steel springs. In order to convey the water in and out of the piston, deflecting plugs are inserted at the proper point in the rod bore. A cast-iron jacket surrounds the tail rod and receives the water emerging from it, whence it is drained away. The many difficulties arising in providing a suitable packing gland for the cylinder heads have been overcome by means of a simple metallic packing similar in some respects to that used on high pressure steam engines. It is compact, may be easily removed without dismantling the engine, and is capable of being made as tight as desirable without introducing friction to a noticeable degree.

Valve Gear.—The one lay shaft paralleling the cylinders operates through cams, all of the valve movements of the engine. Independent cams are provided for inlet valves, exhaust valves and igniters, so that the action of each valve may be timed in order to secure the maximum efficiency of the cycle. The main cams are all of cast iron, with working surfaces chilled and ground. Eeach has a throw of one inch, which is communicated to the valve spindle by levers fitted, at one end with hardened steel rollers engaging the cams and at the other with adjustable steel tappet pins engaging the ends of the valve stems. All igniters, which are of the standard Westinghouse make-and-break type as employed in the single-acting type engine, are operated by a quick drop cam which is mounted in such a manner as to enable the ignition point to be carried any number of degrees in advance or following dead centre as may be most suited to the gas used.

Governor.—Close and sensitive regulation is secured through a spring-weighted, fly-ball governor mounted upon a vertical shaft

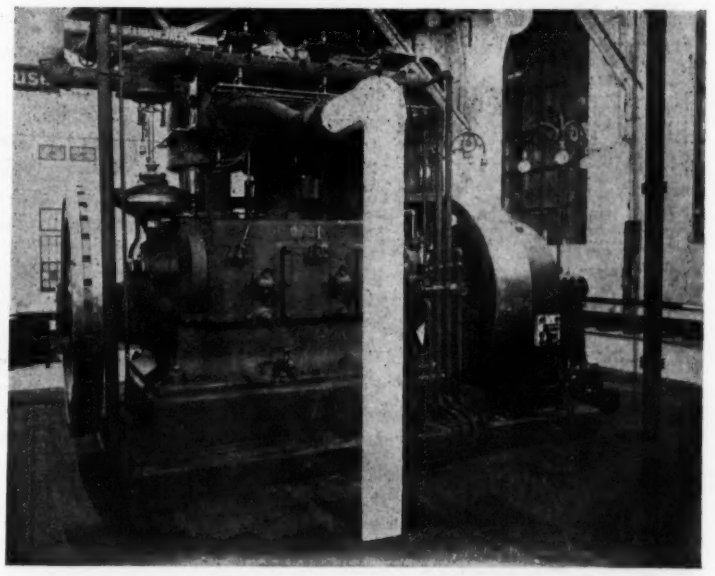


FIG. 2.—125-HP VERTICAL GAS ENGINE, MACHINERY HALL.

geared to the lay shaft. This governor is in many respects similar to that employed in the Westinghouse-Parsons steam turbine and consists of bell crank ball levers swung on knife edges and encased in neat and substantial iron housings. By means of a special spring external to the governor the speed of the engine may be changed within small limits, this expedient being found quite necessary in synchronizing alternating-current generators and in distributing the load between them after having been thrown in parallel. The governor mechanism is easily kept lubricated by an oil cup at the top of the spindle.

Mixing Valve.—As before referred to, the governor controls the speed of the engine by varying the quantity of mixture admitted at each induction stroke. The proper proportioning of air and gas, as well as the controlling of quantity to suit the load, is accomplished by means of a two-part valve. Each part is rotatable by means of an external lever moving over a graduated arc, and the proper proportioning of air and gas may be readily ascertained while the engine is in operation. Independently of this operation, however, the vertical movement of the government valve as it receives its motion directly from the governor determines the quantity of mixture passing into the gas boxes which extend in either direction from the mixing chamber to the four cylinder admission ports. Gas and air are admitted to the mixing valve at atmospheric pressure, secured, in the case of the gas inlet, by an automatic diaphragm pressure regulator located in the basement. With proper adjustment, whatever the pressure of the gas on the supply main, gas is always delivered to the engine at atmospheric pressure.

Starting.—One of the difficulties formerly encountered in gas engine work was the provision of a convenient and reliable means of starting the engine. This is done, as in all Westinghouse engines, through the use of compressed air. In this case, the rear cylinder is used for this purpose and is provided at each end with small spring-backed poppet valves opening only with the air pressure. This cylinder is for the time being converted into a simple compressed-air motor by throwing out of service the main admission cams and throwing in two auxiliary cams which engage the exhaust valves in a double-throw instead of a single-throw movement. Two additional double-throw cams, permanently mounted at right angles upon the lay shaft, serve to admit compressed air at the proper moment to the starting cylinder. These operations, though apparently complex, are extremely simple in practice and involve only the temporary alteration of the cam movement by means of convenient levers, and the admission of the compressed air which is controlled by a single plug valve. One attendant standing at the rear cylinder can readily start the engine without changing his position. After one or two strokes by compressed air, the regular combustion cycle in the forward cylinder commences and the supply of compressed air may then be cut off, the cam mechanism returned to its normal position, and the rear cylinder then comes into regular service. The entire operation of starting may be readily accomcomplished within one minute, and the fact is on record that with the vertical single-acting type of engine, a number of 300-hp units have been started cold, run to full speed within a period of 25 seconds, and full load applied within 40 seconds. Compressed air for starting is supplied by a double-acting compressor in the base-

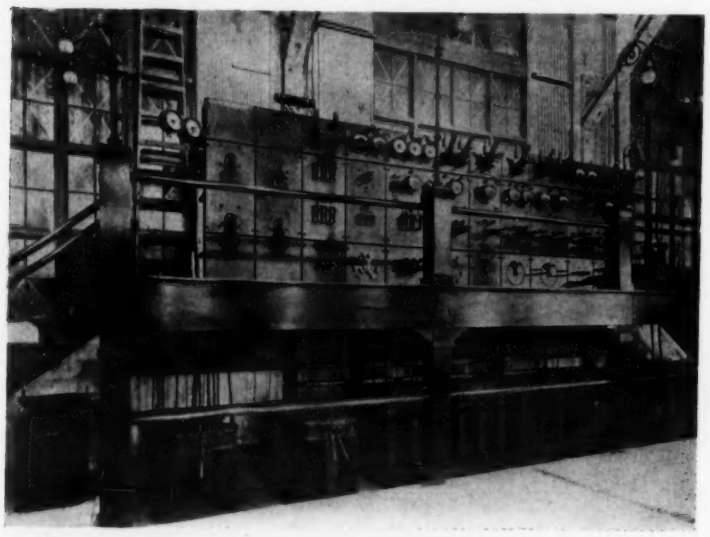


FIG. 3.—EXHIBIT SWITCHBOARD, MACHINERY HALL.

ment, driven by a 5-hp motor through Morse chain gear. The air is stored at about 150 pounds pressure in three steel tanks.

Lubrication of the cylinders is automatically accomplished by reciprocating sight feed oil pumps operated from two of the cam levers. These pumps receive their supply from reservoirs mounted just above them, fitted with glass windows at either end so that the attendant may readily observe the height of the oil and prevent damage to cylinders and pistons from discontinuance of the oil supply. Other parts of the engine are lubricated with the usual oil cups with the exception of the crank pin, for which a special device is provided consisting of a circular groove turned in the outer face of each disc. Oil is conducted to this groove by a small pipe, and the centrifugal action forces it outward through ducts leading to the wearing surface of the pin.

Circulating Water is piped to the several parts from cast-iron water boxes, or headers, located beneath the floor. These receive their supply from the Exposition water system, and all parts of the engine are supplied in multiple from these headers.

The principal difference in construction of the vertical engine, outside of the different arrangement of cylinders, results from the employment of the single-acting principle, in which only the upper side of the piston receives the pressure of the expanding gases. A long trunk piston is, therefore, made use of, thus dispensing with the crosshead. The distinguishing characteristic of the vertical engine is its self-contained construction, all the main moving parts being enclosed in a cast-iron casing which is filled with oil up to the shaft. The cranks during their revolution dip into this oil and furnish splash lubrication to all the internal parts, including connecting rods and pins and cam shaft, which is also mounted inside the crank case. The construction of the engine in other particulars and its operation resembles closely that of the horizontal engine and needs no further description. The performance of the vertical is, furthermore, approximately the same when the difference in their size and construction is taken into consideration, this fact resulting from the employment of the same working cycle in the two types of engines.

The Carbon Brush.

BY HOWARD S. KNOWLTON.

The carbon brush has long been regarded by the designers and users of direct-current machinery as the fortunate solution of an exceedingly troublesome problem. There would seem to be little need of defending it at this stage of electrical development, although a recent contributor to the London *Electrical Review* strongly advocates a return to copper collecting devices, chiefly on the grounds of superior conductivity and resulting decrease in commutator length.

It is true that the modern commutator is a costly and complicated device, and if its dimensions could be reduced without undue increase of wear and tear or sacrifice of reliability, progressive designers would jump at the chance to lessen the factory cost of generators and motors. Experience, however, indicates that the carbon brush is the controlling factor in the situation, and there is little reason to believe that it can be superseded by copper. Perhaps no other feature of design determined the commercial success of railway motors as strongly as did the carbon brush, and in lesser degree the success of large direct-current dynamos in central station service. The copper brush was "weighed in the balance and found wanting," and if the carbon brush had not come to the rescue there is little doubt that the applications of electricity on a commercial scale for power purposes would have suffered a crushing setback.

As the carbon brush stands to-day, it is a prime necessity of the largest continuous-current generators and the smallest fan motors; it facilitates sparkless commutation; imparts a smooth glaze to the commutator surface instead of grinding and cutting it into deep furrows, after the manner of the old copper brush, and in general gives far less wear and trouble than did its prototype. The tendency of the carbon brush to heat more easily is offset in a measure by a decrease in resistance as the temperature rises, and it is seldom that any serious trouble arises from this cause with the current densities in use to-day. Then, too, the carbon brush is practically self-adjusting when once properly set, and it is easily replaced.

It is a common fault in these days to look at problems of this sort from a purely electrical standpoint, and to overlook the importance of operating conditions. As Mr. P. M. Lincoln recently pointed out, the design of transmission lines is influenced by considerations of the spread of eagles' wings, the tip-to-tip dimensions of cats and the throwing powers of juvenile right arms, as well as by matters of inductance, capacity and striking distance, and the same sort of reasoning applies to the operation of dynamos, motors and rotaries. Continuous and reliable service is the vital feature of every commercial electrical enterprise, and the added cost of a few inches more in commutator length is a small matter in comparison with the greater dependability of the carbon over the copper brush. The best way of doing away with the carbon brush and commutator in general power work is to cut the gordian knot by installing induction or synchronous motors, rather than to return to principles of design which the hard school of experience has condemned.

Northwestern Electrical Association at St. Louis.

The Northwestern Electrical Association held a short business session at the Forest Park University Hotel, St. Louis, September 12. After the business had been disposed of, the association adjourned to attend the meetings of the International Electrical Congress, in a great many of the papers of which the members were interested, while several of the members were also members of the Congress. There was a large attendance of members of the association, who manifested much interest in the proceedings of the Congress.

Discussion on General Applications of Electricity by the International Electrical Congress.

THE sessions of Section B were opened Monday by the presentation of a paper by W. M. Mordey, on "Eddies and Hysteresis in Iron," which was read by Prof. Samuel Sheldon in the absence of the author. The author has found, experimentally, that even with sheet steel of small thicknesses the eddy current losses are quite large in comparison with the total iron loss, and are by no means negligible, as is frequently assumed. The eddy losses do not vary as the square of the thickness of the sheets nor as the square of the frequency. In fact, the eddy losses are found to vary according to the 1.6 power of the frequency, as is true of hysteresis and as the first power of the thickness of sheets. This is due to the inductive effect of the electric circuit through which the eddy currents must flow. Thus, in the increase of either the frequency or the thickness of the sheets, the skin effect becomes more pronounced, the net result being that the eddy current loss follows a law more or less the same as applies to hysteresis, depending on the relative values of the hysteretic constant of the iron and the electrical conductivity of the material. It is suggested that the proper method for testing for iron loss is with a wattmeter using sheets of commercial size.

In his paper on "Magnetic Viscosity," which was read by Mr. W. I. Slichter, Mr. M. R. Jouaust described experiments to show the presence of an appreciable time lag in the building up of magnetism after the application of a magnetomotive force. This effect is found to be more prominent if the magnetism is taken from a certain small positive value to a similar negative than when decreased, through the same range, from a large positive to a small positive value. It is attributable to the sluggish movement of the molecular magnets at the period of instability. It is found also that there is generated by the change in flux a local current which tends to retard the change. With large masses of steel the viscosity effect is quite noticeable, but with commercial laminations it is inappreciable. The effect has been noted with other magnetic materials as ferro manganese, and especially in cast metals.

In discussing this paper, Prof. Steinmetz stated that it had been frequently assumed that the loss per cycle due to hysteresis depended not only on the maximum density, but also on the rapidity of reversal. Investigations have shown that for commercial frequencies hysteresis is represented by so much energy per cycle and is practically independent of the frequency. A fact which has a bearing on engineering work is that the flux produced by a certain magnetomotive force is less for alternating than for direct current. This fact is of importance with alternating current railway motors and various types of meters. Prof. H. J. Ryan called attention to the necessity of observing the shape of the curves in alternating current work, and stated that results obtained with wattmeter tests of losses and Duddell oscillograph records of shape of waves would furnish valuable information for investigators of these complex phenomena. Mr. Ford reported the results of tests made at Columbia University to determine the effect of eddy currents upon the hysteresis loop. Experiments had shown that the sharp points of the loop were not rounded, due to any increase of frequency, but that any rounding observed could be attributed to eddy currents in the iron. In commenting on Mr. Mordey's paper, Dr. Sharp said that true test results could best be obtained with iron sheets built up to convenient commercial size, a wattmeter being used for finding the iron loss. For minimum loss there should be used iron having high specific resistance and low hysteretic constant. Prof. C. A. Adams drew attention to the fact that the shape of the curve showing the relation of iron loss and frequency would depend upon the constants assumed for the hysteresis and for the eddy loss. He stated that the results of tests which had been made upon commercial iron sheets when subjected to various densities at different frequencies were quite consistent for frequencies between 25 and 300 cycles per second, when the assumption was made that the eddy loss varied as the square and the hysteresis as the 1.6 power of the density, proper values for the constants being thus determined. With reference to the determination of the hysteresis loop of transformers, Mr. Duddell outlined a most interesting method involving the use of an oscillograph for showing the loop directly. On the transformer core is wound a coil of few turns in which will be generated an e.m.f. proportional to the rate of change of the flux threading the coil. This e.m.f. sends current through a circuit of which the inductance is quite large in comparison to the resistance. The e.m.f. of the coil will be $e = \frac{d\,\Phi}{d\,t}$. In an inductive circuit $e = \frac{L\,d\,i}{a\,t} + r\,i$, and where r is negligible, i is directly proportional to Φ. Thus the current in this local (exploring) circuit is an indication of the flux in the core. With open-circuited secondary of the transformer, the primary current furnishes an indication of the magnetomotive force necessary to produce the flux. By means of an oscillograph with mirrors in mechanical quadrature, the current in the exploring circuit gives a vertical motion to a spot of light, while the current in the primary circuit gives a horizontal motion to the spot, the spot tracing a path corresponding to the hysteresis loop.

Dr. C. H. Sharp read his paper on "The Equipment of a Commercial Testing Laboratory," which dealt with laboratories intended not for purposes of instruction, but as commercial enterprises. Thus the prime requisites are dispatch, accuracy and economy. This paper, which was abstracted in these columns last week, was not discussed.

Dr. C. P. Steinmetz abstracted the paper of Mr. Albert Nodon on "Electrolytic Rectifiers—An Experimental Research." It is impossible to obtain an unidirectional electromotive force by magnetic induction with stationary apparatus, due to the fact that a changing flux which produces an e.m.f. of one sign when increasing in value, must give an e.m.f. of reversed sign when its value is on the decrease. Therefore, electromagnetic apparatus for producing unidirectional e.m.f. must be of the open magnet circuit type, and one part must slide or rotate with reference to the other, and in general a commutating device must be employed. With the electrolytic rectifier or the so-called electrolytic valves, the current is allowed to flow more freely in one direction than in the other, the effective resistance being small for current in one direction and large for current in the other direction. When the valve effect is perfect the effective resistance is low for current of one sign and is infinite for current of the other. A certain hysteresis effect is produced at the surface of the electrode, the process occurring at this place not being entirely reversible and resulting in an energy loss. This loss is constant and forms the no-load loss of the rectifier. The efficiency is determined by the value of this loss and an additional loss which varies with the square of the local current, due to the resistance of the circuit through which the current must pass. A single rectifier gives an interrupted pulsating current. By the combination of several rectifiers whose current are superposed or which are used with energy storing dvices, a truly unidirectional and constant e.m.f. or current may be obtained. The proper arrangements to be used are described by the author.

The paper of Mr. B. A. Behrend on "The Testing of Alternating Current Generators" (abstracted last week), was read by Mr. W. I. Slichter. Prof. H. J. Ryan, on account of the great convenience and efficiency of the method proposed by Mr. Behrend, suggested that a systematic comparison of results obtained by actually loading various machines and by calculations based upon the method proposed, would be most interesting and instructive as furnishing constants of design of different types of machines. Mr. W. L. Waters expressed his doubt as to the accuracy of the results to be obtained from machines of widely different types by the Behrend method. He has found that very good results may be gotten from passing direct current through the divided armature circuits and that the vibration of the machine, while of appreciable magnitude, does no harm. On account of the field coil circuit being cut by the magnetism due to the direct current in the armature, a short-circuit current is produced in the field coils, and the effect of this action must be taken into account. The method of loading the machine with inductive coils for a short time serves to heat up the machine, while the power-factor being low the energy consumed is small and the results are quite satisfactory. Mr. D. B. Rushmore stated that an asymmetrical connection of the armature conductors so as to give unbalanced e.m.f. in the locally closed armature circuit had been found to give good results. In fact, commercial accuracy was obtained by determining the regulation from the short-circuit and open-circuit tests, using either the magnetomotive force or the electromotive force methods. Mr. Steinmetz laid emphasis on the fact that the best method of testing an alternator for efficiency, temperature rises and regulations, is by actually loading the machine. Such procedure is practically impossible with large generators and methods of calculaton must be used. Experience has shown that the calculated results were even more accurate than the observed results due to the difficulties in controlling the condition of a test

under load. An excellent plan is to operate the machine on short circuit for a certain time and on open circuit with excess excitation for a certain time, in order to get the full temperature rise. The length of time for each condition of test depends upon the type of machine, and experience shows the values to be assigned to each. Prof. C. A. Adams stated that whether the electromotive force method or the magnetomotive force method should be used depended upon the type of machine being tested. The electromotive force or reactance method had been found good for all types of machines.

On Tuesday, September 13, Sections B and F met in joint session. The first paper of the day by B. J. Arnold on "Some Early Work in Polyphase and Singlephase Electric Traction" referred to the history of the work done by the author since 1896 in the solution of traction problems. In 1899 it was recognized that there was a demand for some system which would require only one working conductor, would produce a steady load upon the power house, which would use single-phase alternating current in that conversion and which would comprise an independent unit for switching purposes. The principles underlying the system which he developed to accomplish these results were a single-phase motor mounted directly upon the car axles, designed for the average power requred by the car, running at a constant speed and a constant load, and, therefore, at maximum efficiency. Instead of stopping and starting this motor and dissipating the energy through resistance, the speed of the car was controlled by retarding the parts usually known as the rotor and the stator, by means of compressed air in such a manner as not only to regulate the speed but also to store the kinetic energy of the car when stopping and utilizing it in starting. Details of the machine necessary to carry out this idea are given.

Prof. C. P. Steinmetz then presented his paper on "Alternating Current Motors," which is an elaborate general mathematical treatment of the subject. The paper on "Single-Phase Motors," by Max Deri, was read by Mr. Slichter, this also treating the subject from the mathematical standpoint. Marius Latour presented his paper on "Single-Phase Motors," which discussed in particular the compensated repulsion motor upon which he has been working for several years. In regard to the commutation, he showed that the e.m.f. in the coil short circuited by the brush has two components, one due to transformer action and the other due to speed. The former is practically constant while the latter varies with the speed. At synchronism the two components are equal in value and being opposite in phase, the resultant is zero, so that the commutation at this speed is perfect. The paper disclosed a method for improving the commutation at all speeds by use of coils connected electrically in shunt across the power circuit and placed mechanically so as to generate a proper counter e.m.f. in the coil under the brush, thus eliminating the sparking troubles. Dr. O. S. Bragstadt's paper on "Theory and Operation of Repulsion Motors" was abstracted by Prof. C. P. Steinmetz. The paper is mathematical in character, a general equation for the repulsion motor being derived, and the conditions which must be fulfilled to give maximum power, maximum torque or maximum power-factor are discussed. A method of determining the characteristics of the machine from open circuit and short circuit tests is given. This method corresponds closely to the one which is applicable to induction motors and transformers and to the one which is used in the synchronous motors and generators. The author uses the method of complex quantities and gives diagrams to represent his equations. Prof. Steinmetz abstracted briefly to the paper by Ernst Danielson on "The Theory of the Compensated Repulsion Motor." The author determines the distribution of the magnetomotive force and the flux, and in this way derives a general equation for the machine. He treats of the compensation and of the conditions for obtaining good commutation and reports the results of tests on certain motors. The paper is largely mathematical and cannot readily be abstracted. Mr. P. M. Lincoln presented a paper on "Transmission and Distribution Problems Peculiar to Single-Phase Railways," an abstract of which was given last week.

The paper by Dr. F. Niethammer on "Alternating vs. Direct-Current Traction" was presented to the members in printed form and was not read, owing to its great length.

In discussing the relative advantages of three-phase and single-phase motors as to the torque exerted by each, Mr. E. K. Scott compared the machines to three-crank and single-crank engines. The polyphase and the direct-current motors give constant torque, but the torque of the single-phase series motor is pulsating. In order that the wheels of an electric locomotive do not slip when equipped with alternating current series motors, it must be sufficiently heavy to adhere to the track for maximum torque, and, therefore, the locomotive must be larger than when direct current motors are used. In a three-phase delta-connected system, if one transformer is damaged the other two will carry the load, but in the single-phase system the loss of one transformer shuts down the circuits. Mr. B. G. Lamme explained why the air-gap of a single-phase series motor could be made so much larger than that of induction motors without detrimental effect upon the power factor at operating speeds. A fact which seems little appreciated is that with the single-phase motor, both wattless and energy current produce torque, while with the induction motor only the power component of the current represents torque. Thus a low power factor at starting does not indicate poor torque. On the contrary, the lower the power factor the better the motor, since all power current indicates internal losses. The Westinghouse Company uses the directly compensated motor with exact compensation. The method of determining the degree of compensation is to short circuit the compensating coil while current flows in the armature. If the compensation is excessive current will flow in the local circuit in one direction; if too weak, the current will flow in the other.

In discussing the relative advantages of single-phase and polyphase induction motors, Prof. C. P. Steinmetz stated that the operating range of the single-phase motor is much more limited than that of the polyphase. The polyphase motor could be used for railway work but the single-phase is unsuited except by some such scheme as that used by Arnold. The commutator motors are not limited as to speed range, the torque varying inversely with change of speed as with the direct-current machine, and closely as the square of the current. A polyphase motor gives a torque varying as the first power of the current. The single-phase commutator motor shows the best torque efficiency; that is, the ratio of torque to volt-amperes input is largest. In reply to the criticism of Mr. E. K. Scott, Prof. Steinmetz stated that single-crank tandem compound engines were found to be as good as two-crank engines, the pulsating torque not being objectionable. He directed attention to the fact that there is no dead-center with a series motor, the torque pulsating at a rate depending upon the frequency and quite independent of the speed. As to the type of generator to select, a polyphase generator is somewhat smaller than a single-phase machine and polyphase motors are preferable for stationary duties. It seems best to generate polyphase and distribute single-phase. The ideal system is single-phase for both generation and distribution. Mr. A. H. Armstrong stated that railways being installed must conform as nearly as possible to existing systems. Thus the power which is now available from polyphase 25-cycle generators cannot be ignored. Power can be generated three-phase and distributed two-phase by the Scott system, which method seems best to meet present requirements.

Mr. H. W. Leonard stated that he had early been an advocate of the single-phase system for railway work, and described the electric locomotive known by his name. The Arnold system is similar to his in many respects and its power storage feature is advantageous. This feature is, however, obtained at the cost of simplicity, the necessity for valves and reciprocating parts rendering the system less reliable than his own. In the Leonard system the high-tension circuits are brought to one well protected stationary motor so that trouble from this source is reduced to a minimum. In comparing the weights of various equipments he finds that his own is the lightest per horsepower of motor. The special virtue in his system lies in the fact that the energy supplied to the motors on the axles is proportional to their demands, and none need be dissipated in resistance. It is a good feature to have the field and armature circuits independent, since by this means the slipping of the wheels which occurs with series motors may be avoided, giving electrically the effect of the parallel rods on steam locomotives.

In commenting on the Bragstadt paper, Mr. W. L. Waters remarked that, while the best method of representing the performance of motors is by means of graphical diagrams, the computation connected with single-phase motors required analytical equations, and it is best to use both the graphical and analytical methods. In regard to the transmission circuits, it is evident that compared upon the proper basis of e.m.f. to neutral point, the single-phase system is equally as good as the three-phase.

Mr. P. M. Lincoln stated that the Westinghouse Company had at first advocated a low trolley voltage which would permit of the

use of insulation then available for street railway work. Thus, standard insulators were adequate for 1,100 volts, but were too weak for 2,200 and 3,300 volts. At present, however, trolley insulators conforming to standard practice are available, which will withstand the latter pressures.

At the opening of Section B, on Thursday, Prof. S. P. Thompson not being present, Prof. C. P. Steinmetz abstracted his paper on "Plunger Electromagnets," which dealt with the problem of the proper design of plunger magnets, so as to give a force which varied but little throughout a large range of stroke. The author shows how to calculate the reluctance of the magnetic path and to determine the m.m.f. necessary to produce a given flux. The problem, which is quite easy for closed magnetic circuits, becomes quite complex when open circuits are used, due to the so-called demagnetizing effect of the end poles. He explains the method of ascertaining the surface to be given to the coil which must dissipate a certain amount of heat when the magnet is used either for constant service, temporary service or intermittent service. The method of magnetic images is employed. It is shown that the equivalent effect of a long magnet may be obtained by means of plates at the pole ends.

The paper by Prof. E. B. Rosa, Dr. M. G. Lloyd and Mr. C. E. Reid on "Wave Shape and Meter Indications," represented the results of tests made at the Bureau of Standards to determine the effect of variation of wave form of e.m.f. upon the indications of the meter. The tests so far as reported were made upon American types of induction meters operating at full load and constant temperature. In order to obtain variation in wave shape, two alternators, one having three times as many poles as the other, were mechanically coupled to the same shaft and electrically joined in series. The field strength of each was independently variable and the mechanical position of one in reference to the other could be changed at will, so that any value of the triple harmonic could be superposed upon the fundamental at any phase position. A chronograph was used to record both the time and the revolutions of the disc and thereby the mean period of the meter was calculated. The load was kept constant and the speed and voltage of the generator were held at constant value. The frequency was found by means of a chronograph which noted the time of every fiftieth revolution of the alternator. The temperature of the meter was kept constant throughout the test by alternately loading with current of sine wave and of distorted wave after bringing the instrument to load temperature. Power supplied to the meter was measured by means of wattmeters of the dynamometer type contained in a wooden case so as to eliminate the effect of local magnetic material. This was calibrated on direct current by comparison with potentiometer and standard instruments. The results of the tests indicate that while the higher harmonics do have a slight effect upon the readings of the meters the error of neglecting such effect is within the range of commercial accuracy.

Mr. D. B. Rushmore remarked that the distortion of the e.m.f. wave of a single coil armature was such as to introduce the third harmonic, as done by the investigators, and emphasized the importance of the work being accomplished, mentioning the fact that as electrical engineering progressed, more and more attention was paid to the shape of the waves of e.m.f., which formerly was neglected. Prof. Rosa stated that arrangements were now being made to couple together eight alternators having poles in the ratio 1:3:5: — — — 15 so that by change of position and value of the various e.m.fs. produced, any shape of wave desired could be obtained. In reply to questions as to the method of determining the shape of wave used, Prof. Rosa stated that, since the armature reaction on each alternator was quite small and constant, the mechanical position of each armature relative to the other would give a fair indication of the wave, but that in all cases the wave shape was accurately observed by proper instruments. Prof. C. A. Adams said that tests had shown that the error of integrating meters varied with change in power factor, but that the effect was much less than one might reasonably expect. As to the value of upper harmonics, he pointed to the fact that when a synchronous motor was operated without load from the circuits of a generator giving a different wave shape, the superposed local currents frequently more than equalled the fundamental current.

In commenting on the paper of Prof. H. J. Ryan on "The Design of Insulators," abstracted last week, Mr. D. B. Rushmore expressed his appreciation of the valuable work done by Prof. Ryan in placing the insulation of electrical machinery on a scientific basis in so simple a manner. He referred to the fact that while formerly cotton covering was depended upon for insulation in transformers, the tendency to-day is to use some separator for the conductors and depend entirely upon oil for insulation. In reply to Mr. Rushmore's question as to the existence of dielectric hysteresis, Prof. Ryan related his experiences with the heating of dielectrics, which seemed to show that, while such hysteresis might be present, the heating could in every case be attributed to local weakening of the dielectric under excess stress which rendered it conducting, after which it heated rapidly and finally gave way.

Mr. C. Day read his paper on "Electric Motors in Shop Service," abstracted last week, after which Sections B and E combined to discuss Col. R. E. Crompton's paper on "Standardization of Dynamo Electric Machinery," which had been read the day previous.

Mr. J. W. Lieb, Jr., called attention to the frequency of 50 cycles which the English committee had suggested to fill the duty performed by the American 60 cycles, and thought that the two countries should combine on a common value. Prof. C. P. Steinmetz remarked that the difficulty in specifying standard frequencies is due to the fact that there are three supreme courts for discussion, the electrical engineer, the customer and the builder. Fifty cycles had been tried in this country in '92-'93, but practice crystalized toward 60 cycles, which value has been the accepted one here for the past six years. It does not seem possible that America could adopt 50 cycles, though, perhaps, a common frequency for both England and America could be found in 60 cycles. Col. Crompton related the reasons for the suggestion of 25 and 50 cycles as standard frequencies. Fifty cycles can better be used for rotary converters than 60 cycles, while a lower frequency, such as 40, while better for converters, is not suited for general illumination. The ratio of 50 to 25, the best frequency for general power purposes, is just 2 to 1, and furthermore, Germany has adopted 50 cycles.

Mr. C. F. Scott stated that from personal observations he had found a great need for standardization in England, where the number of frequencies in use is simply appalling. In America the conditions differ from those in England, since a few large companies control the manufacture of machinery, and the engineers have early recognized the advantage of standardization. A danger which may follow standardization is a checking of progress of development. The suggestions should be given as a guide, not as a law. Dr. R. T. Glazebrook wished to correct the impression that in England the suggestions made would become law, since in reality there could be no rigid rules laid down and no supreme council to see that they were followed. The suggestions would be availed of in just so far as they proved proper for the conditions existing.

Prof. F. B. Crocker related his early experience in standardizing apparatus. Trouble to get people to adopt the suggestions which was anticipated did not develop and no supreme council was needed to enforce the rules. He objected to the use, common both in this country and in England, of the contradictory term *slow speed*. The expressions should read *high speed* and *low speed*. He strongly urged that standardization should be of performance, not construction of machines. President R. K. Gray, of the (British) Institution of Electrical Engineers, agreed with Mr. Scott as to the suggestion for guidance and not law in connection with standardization, which should be made in conformity to the wishes of all concerned and not involve the necessity of compulsion in its adoption.

Prof. Moise Ascoli expressed his appreciation of the work being done, and stated that though no standardization had as yet been attempted in Italy, the engineers of that country would profit by the suggestions now being made when they undertook a similar task. Col. Crompton, in closing the discussion, thanked the Congress for the attention paid the subject and expressed his pleasure at the general accord of opinion of the American and English engineers as to standardization, the only difference noticed being in regard to the frequency. He stated that the Board of Trade which had relatively considerable power in England, had in the past issued rules which were valuable for the protection of lives from electrical dangers. No compulsion had been used and no obstruction to progress had been offered. Recently the upper limit to low-tension voltage had been raised to conform to improved conditions of insulation.

At the opening of the final meeting on Friday, the paper by Mr. F. J. Eichberg on "Single-Phase Electric Railways" was presented in abstract by Prof. C. P. Steinmetz. The paper described the type of single-phase commutator motor known as the Winter-Eichberg

machine, which gives the series motor characteristics. The motor possesses two sets of brushes, mutually at right angles to each other. One set receives the energy current by transformer action and the other exciting current by direct series connection in the circuit. It was shown by Prof. Steinmetz that the general type of commutator motor contains four circuits, two on the stator and two on the rotor; of these, only two are necessary for operation, one for energy and the other for excitation current. With the type of motor described three circuits are used, two of which are on the motor. The motor is quite similar in operation to a repulsion motor. Mr. W. I. Slichter abstracted the paper by M. Andre Blondel on "Calculation and Tests of Alternators," which treated of the various methods of determining the performance of an alternator either by culculation or by test. Where two similar alternators are to be tested a convenient method is to connect them together mechanically and shift the relative phase of the two so as to cause a current to circulate locally through the armatures. A third machine which drives the set supplies the losses of the machine, while the motor machine of the set feeds back energy to the generator through the coupling shaft. He mentioned also the method of dividing the pole windings of a single machine into two groups and varying the current of the groups. This gives a motor-generator effect to the armature which is equivalent to loading the machine, where a large number of poles is used, but leads to error with machines having but a few poles. Mr. Slichter abstracted also the second paper by M. Andre Blondel on a somewhat similar subject, "Reaction in Alternators." The method followed by the author involves the determination of the magnetomotive force of the armature ampere turns and dividing the leakage flux due thereto into two components, the demagnetizing and the distorting. Account is taken of the effect of saturation of the armature and field cores. For single-phase machines the alternating magnetomotive force is resolved into two components, each of half value, revolving uniformly in opposite directions on the armature core, one, therefore, being stationary in space and the other traveling at double speed. Thus the reaction is pulsating in each machine. The author treats of the effect of the variation of the number of slots for single-phase and polyphase machines and shows methods for reducing the distortion.

Mr. W. I. Slichter abstracted briefly the paper by M. Paul Boucherot on "Kinetic Variation of E.M.F. in Dynamo Electric Generators and Its Influence on Their Operation in Parallel," which dealt with both direct and alternating-current generators, the dynamic action of a pendulum being the basis for the treatment with alternators. This paper was not discussed.

Prof. C. A. Adams presented his paper on "Leakage Reactance of Induction Motors," which was a report on an experimental investigation of the effect on the leakage reactance of shifting the relative positions of the rotor and stator cores. In order to magnify the reactance effect, a high-frequency was used in the tests. The tests showed that an appreciable variation takes place according to the position of the rotor, and that this variation cannot be attributed to the interlocking of the primary and secondary slots, but is due mainly to the formation of definite bands of magnetomotive force by both the primary and secondary currents, and the effect, therefore, depends greatly upon the number of secondary phases, being quite large for a three-phase winding and inappreciable for a cage-wound secondary. Experiments showed a remarkable agreement between calculations and observations. Mr. D. B. Rushmore stated that the facts brought out were applicable to all classes of machinery. It is only in recent years that the designers of direct-current machinery have been considering the effect of the self-inductance of the armature coils. While the results sought are different in the several cases, the facts involved are the same in each. In reply to a question by Mr. Karapetoff, as to the effect upon the current taken by the induction motor on shifting the rotor and as to methods of separating the primary from the secondary leakage reactance, Prof. Adams stated that the variation of current with a cage-wound rotor would be very slight indeed, due to the prime relation between the primary and secondary number of slots, but that with certain coil-wound secondaries the variation was as much as 30 per cent. As to the calculations of the reactances, they had been found to check within 5 per cent. of the test values.

Mr. D. B. Rushmore presented his paper on "The Regulation of Alternators," which gives by description, inference and reference a summary of work done and of the methods commonly used for determining regulation and the results of very careful tests on widely different types of machines. The paper forms a contribution of real value concerning actual operation under many different conditions. The results of the tests are given in 27 curve sheets, which are accompanied by complete design data in order that the many possible valuable deductions may be made therefrom. The paper is especially valuable on account of the test data, in obtaining which the greatest care was taken with methods and instruments and on account of the fact that only those observations which could be repeated, have been recorded. Dr. C. V. Drysdale described a method of determining the regulation by use of the short circuit and open circuit characteristics. In this method there is plotted a third curve which represents the square of the magnetic reluctance of the machine, found as the ratio of field current to armature e.m.f. at full speed. By locating certain points on this curve by use of the short circuit characteristic at a given load current, the terminal e.m.f. of the generator is found on the excitation characteristic. The method takes into account the change in reluctance of the magnetic path and is, therefore, preferable to a method which neglects such change.

The paper by Alexander Heyland on "Recent Developments in Compounded Alternators With Alternating Current Self-Excitation" was abstracted by A. S. McAllister. An abstract of this paper appeared last week. Mr. V. Karapetoff remarked that Mr. Heyland had devised numerous new types of machines in recent years, all of which involved the use of a special commutator. He explained that the most valuable feature of recent developments resided in the means for increasing the excitation of the generator directly with the wattless component of the armature current, while the power component had no effect upon the excitation. He pointed to the fact that periodically new and improved schemes were proposed by Mr. Heyland, a recent one involving the use of a separate exciter for the main field current while retaining the special commutator for counteracting the effect of the wattless component of the load current. A recent scheme consisted in causing the wattless component of the load current of the generator to increase the field strength of a separate exciting generator. Prof. Adams stated that the self-exciting features introduced by Mr. Heyland might prove advantageous for small plants, but they necessitate undue complications for large plants and central stations, where the use of separate generators for excitation is preferable. Mr. C. V. Drysdale remarked that the Heyland generators operated very satisfactorily under test, and he thought that the auxiliary excitation of the exciting generator suggested many inviting possibilities. Mr. Rushmore said that schemes for compounding which are carried out on the generator itself are in general expensive and complicated. Methods are now in satisfactory use for performing this work external to the armature circuits of the generator and these seem to be preferable.

The paper by H. M. Hobart on "A Method of Designing Induction Motors" was given by Prof. H. J. Ryan. An abstract follows:

The author gives a few remarkably simple formulas from which may be determined the proper design of induction motors, factory cost of the machine being properly considered. He shows that a practical and sound design can be based upon the requirement that the gross core length in centimeters be 14 times the polar pitch at the air gaps (i. e., the circumference at the air gap divided by the number of poles). The author proposes to use this relation in conjunction with a suitable value of the "output coefficient" as the ultimate basis for the design of induction motors. The output coefficient is the ratio of the watts output to the product of speed in r.p.m., gross length in centimeters, and the square of the diameter at the air gaps in centimeters, and it varies from 0.0009 for a 10-hp motor to 0.0018 for a 1,000-hp machine. The method has been tested in many cases and appears to afford the readiest means for obtaining a practical and economical design which has thus far been produced.

Mr. D. B. Rushmore remarked that the author, being a designer of machines, was most liberal with his information, being a frequent contributor to the technical press. He felt that the electrical engineers owed a debt of gratitude to Mr. Hobart for the paper at hand, which so admirably presented the requirements of good design for induction motors based upon actual experience with the machines. The papers now being read before conventions of engineers represent, he said, a change of attitude of the members of the profession. Much good is being accomplished through the free interchange of ideas which were previously held as trade secrets. Engineers have ceased to withhold information, and advantages have thereby been gained on all sides.

Annual Convention of the National Electrical Contractors' Association.

The National Electrical Contractors' Association held its fourth annual convention in St. Louis, on the 14th, 15th and 16th of September. The meetings were held on the tenth floor of the Century Building. All of the meetings with the exception of the morning session of September 16 were held behind closed doors.

At 10 a. m. on September 14 the meeting of the national board of directors was held. This adjourned for the opening meeting of the convention at 2 o'clock in the afternoon. In the absence of Hon. Rolla Wells, Mayor of St. Louis, who was to have given an address of welcome, Mr. E. C. Van Nort, president of the local organization, addressed the assemblage. He stated that the St. Louis organization recognized the fact that members of the convention were in the city first for business and secondly to visit the Exposition. He assured them that members of the St. Louis branch would do everything in their power to make their visit a pleasant as well as a profitable one. After complimenting the officers of the association on the efficient manner in which affairs had been conducted, he closed by presenting to the convention Mr. E. McCleary, president of the national organization, who responded to the address of welcome.

A business session behind closed doors was held on September 15. The morning of September 16 was taken up by a meeting to which manufacturers and the Western Supply Dealers' Association had been invited. Questions of mutual interest to the three bodies present were frcely discussed. After the meeting the Electrical Contractors' Association had its last session, which was held in private.

Boston was selected as the meeting place of the national convention to be held in 1905.

With the exception of W. I. Gray, former vice-president, who was unable to serve another term, all the old officers were elected for the coming year.

Quite an elaborate programme had been prepared by the ladies' auxiliary of which Mrs. E. C. Van Nort was president, for the entertainment of the ladies accompanying the members. On Wednesday morning at 10.30 the ladies met at the Jefferson Hotel for an auto ride through the residential portion of the city and through the World's Fair grounds. Luncheon was served at the eastern pavilion on Art Hill. At 6 o'clock, the ladies were met at the Missouri Building by the members of the association. On Friday afternoon the ladies assembled at the General Electric headquarters in the Electricity Building for a boat ride on the lagoon. At 6 they again met at the General Electric booth where members of the association were in waiting to escort them to a 7 o'clock dinner at Blanke's Cafe on the Pike.

During the evening addresses were made by Mr. Charles Eidlitz, past president and organizer of the association, and by Mr. W. Lowe, president of the Western Supply Dealers' Association.

The event of the occasion, however, was the presentation of a loving cup by the association to Mr. Eidlitz. This cup, appropriately inscribed, was given as a token of appreciation for past and present services.

A feature of the St. Louis Fair that attracted a great deal of attention from delegates to the Electrical Congress, Electrical Contractors' Association and the various other conventions during the week, were the American Diesel engines, that are supplying the power for the popular resort, Tyrolean Alps. Mr. Norman McCarty was constantly in attendance and was, as usual, courteous and painstaking in showing the visitors around and explaining the features of the plant.

Annual Convention of the International Association of Municipal Electricians.

The ninth annual convention of the International Association of Municipal Electricians was held at the Grand View Fraternal Hotel, St. Louis, September 13 and 14. After an executive session at 8.30 on the morning of the 13th the firse regular meeting was called to order at 10.45.

In his opening address President A. C. Farrand referred to the appropriate time and place of the meeting, in that they afforded opportunity to study the electrical exhibits at the Fair and to attend meetings of the International Electrical Congress.

Mr. Walter M. Petty as chairman of the executive committee reported that there was nothing requiring immediate attention. He did, however, speak of the need of making the name of the association and its purpose better known. His remarks led to the appointment of a committee to advertise the association.

The first paper presented for discussion was that of Mr. A. S. Hatch, of Detroit, on "Street Lighting." The methods of placing lamps as well as the different lamps employed were discussed. The ideal lighting system, Mr. Hatch said, was that of employing arc lamps on high towers. This gives even and well-distributed illumination.

The next paper presented was that of Mr. Adam Bosch, of Newark, N. J., the subject being "Limitations of the Telephone for Fire Alarm Purposes." The paper led to a spirited discussion. It was, however, the general opinion that the telephone should be used only as an auxiliary in reporting fires; that in case of fire, the fire alarm box should be pulled first and the telephone used, if necessary, afterward. The excited condition of the person telephoning, the similarity of the names of streets, and the indistinct pronunciation of the foreign element all tended to make the telephone more or less unreliable.

In the absence of Mr. William H. Thompson, of Richmond, Va., the paper prepared by him on "The Inspection of Theatres from an Electrical Standpoint" was read by the secretary, Mr. Frank P. Foster. Discussion of the paper was deferred to the next meeting, the association adjourning until the following morning.

The session on Wednesday morning was taken up with the presentation and discussion of a paper by Mr. Walter M. Petty, of Rutherford, N. J., on "Methods of Testing." He went into a great many details as to the proper way of making periodic and systematic tests of fire alarm circuits, etc., and cited the practices adopted in various communities. Mr. Petty was elected president for the ensuing year.

New England Cotton Manufacturers on Electric Power.

The New England Cotton Manufacturers' Association held its semi-annual meeting this week at the Mount Washington Hotel, Bretton Woods, N. H., when, as usual, some interesting papers were presented, including these: "Electric Measurements of Power Required in Cotton Manufacture," by E. W. Thomas, of Columbia, S. C.; "Electricity in Textile Mills," by Charles Robbins, of New York; "Tests of a 400-kw Parsons Turbine," by George I. Rockwood, Worcester, Mass.; "Automatic Feed-Water Regulators and Low Water Alarms for Boilers," by John Oldfield, Boston. The papers by Messrs. Thomas and Robbins have many points worthy of note. Discussing the merits of electric power, Mr. Thomas said: "I do not consider that the electric drive is a necessity, but I do believe that actual facts would prove it not to be a luxury as many claim. Its advantages in distribution from central points have been very thoroughly presented to the members in previous meetings, so that it is not necessary to enlarge upon that side of the question. I predict, however, that the mills of Lowell, Lawrence, Manchester, Fall River and other large cotton manufacturing centres, each mill now having its own individual power plant, will eventually buy their power from one or more central stations in each city. We have but to look at the immense electric power plants established in New York and other large cities for operating street cars and for furnishing small users of power, and for lighting, where the current is conveyed in all conceivable directions and distances, to render it a very probable outcome for use in manufacturing centres. Electric driving is bringing into use powers on streams heretofore not developed on account of limitations prohibiting the establishment of mills at or near the power station. These powers are now being developed and the current carried to such points as are attractive centres by reason of proximity to labor conditions, and to freight facilities either by water or stream road." Mr. Thomas gave a variety of data as to power required to operate, including wattmeter readings for several motors. Among the tests noted are the following for four different motors: 4.71 looms per hp; 4.93 looms per hp; 4.92 looms per hp; 5.16 looms per hp; after deduction of power required for motors and shafting.

Mr. Robbins' paper dealt more particularly with the possibilities and advantages of turbo generators especially as compared with the old standard reciprocating types of mill engines. With regard to distribution he advocated also the alternating current motor, and in respect to lighting put in a plea for the Nernst lamp on account of its pure white light, its steadiness and its cleanliness.

Electrical Theory at the International Electrical Congress.

THE programme of the International Congress at St. Louis embraced a large number of papers on the general theory of the science. Of these some abstracts were presented in the pages of ELECTRICAL WORLD AND ENGINEER last week, accompanied by notes of some of the discussions. We are now able to supplement the earlier telegraphic reports by the following resumé:

The sessions of Section A were opened on Monday, September 12, by the reading of a paper on "The Mechanical Equivalent of Heat Measured by Electrical Means," by Dr. H. J. Barnes. The paper gives a critical comparison of this constant as determined by mechanical and electrical methods, and presents the results obtained by the author by the use of the latter method. The method is inherently accurate because of the certainty with which corrections can be applied. The results point to the conclusion that substantial agreement between the values of the Joulean constant obtained by the two methods depends upon a reduction in the present value of the Clark cell by about one part in a thousand.

In the discussion Professor Glazebrook pointed out that differences in the value of the constant as electrically obtained by various observers are due to widely different methods of applying corrections.

The next paper on the programme, "Spectra of Gases at High Temperatures," by Prof. John Trowbridge, contains statements of various phenomena observed on discharging a condenser of high e.m.f. through Geissler tubes. The high temperature causes a volatilization of the ingredients of the tubes, and the spectra thus formed mask that of the gas in the tube. The discharges in capillaries also reverse many of the spectral lines on broad bands, as is often the case with gaseous spectra. The author concludes that Kirchhoff's law of radiation applies to the radiation in Geissler tubes.

Next followed a paper entitled "The Alternating-Current Theory of Transmission Speed Over Submarine Telegraph Cables," by Dr. A. E. Kennelly. The author attacks the problem mathematically, using hyperbolic functions. The conclusion reached is that the inductance of the receiver should equal the condensance of the sending circuit, and that these values should also equal the ohmic resistance of the circuit. The results depend upon the assumption that the signals consist of a succession of dots sent at regular intervals, but the author expresses the opinion that the effect of dashes would probably be of secondary importance.

The concluding paper of Monday's session was that by Prof. Townsend, entitled "The Theory of Ionization by Collision," which was read by title. An abstract of this paper appeared last week, page 466.

The first paper of Tuesday was "Systems of Electric Units," by Professor M. Ascoli. The paper advocates the adoption of a rational system of units as proposed by Professor Giorgi, of Rome. The system is rational in the Heaviside sense, that is, it eliminates 4π from the equations involving some of the derived units. In Giorgi's system, the permeability of the standard medium (the ether) is 4π instead of unity, and, in addition, either the international ohm or ampere is adopted as a new fundamental unit, just as the meter has been accepted as the unit of length. The units of length, mass and time in this system are, respectively, the meter, the kilogram and the second, thus differing somewhat from the present c.g.s. units. The system has the advantage, in addition to being rational, of not affecting the present accepted "practical" units (the volt, the ohm, and the ampere) and will prevent change in the future. The fact that no change in practical units is necessary removes legal difficulties from consideration.

The next paper, "The Absolute Value of the Electromotive-Force of the Clark Cell," by Professors H. S. Carhart and G. W. Patterson, Jr., was in two parts. The first, by Professor Carhart, contains a description of the electrodynamometer used by the authors in their work; the second, by Professor Patterson, contains the mathematical derivation of the expression for the torque of the dynamometer. The potentiometer method of determination was used, the e.m.f. of the Clark cell having been balanced against the drop of potential due to the passage of a known current (as measured by the dynamometer) through a standard resistance.

The vital part of the apparatus used is the dynamometer. It consists of a fixed and a movable coil, the former wound on a magnetically neutral plaster of paris cylinder, and the latter suspended by steel or phosphor-bronze wires of small permanent set. The coils are so constructed that the ratio of diameter to length is as 2 to $\sqrt{3}$, which greatly simplifies the calculations. The results thus far obtained show the e.m.f. of the Clark cell at 15° C. is nearer 1.433 than 1.434.

In a paper entitled "The So-Called International Electrical Units," Dr. F. A. Wolff discussed the differences in the units as legalized by the principal European and American nations, and the apparent multiplicity of the same unit in several individual governments. The author recommends some action that will bring about closer unification.

The reading of these three papers was followed by a joint discussion participated in by members of the American Institute of Electrical Engineers and the British Institution of Electrical Engineers. The speakers were Dr. R. T. Glazebrook, Professor A. G. Webster, Professor H. S. Carhart, Mr. H. E. Harrison, Dr. A. E. Kennelly, Professor John Perry, Dr. F. A. Wolff, Mr. C. H. Sharp, Professor Patterson and Mr. Duddell.

The discussion developed a decided tendency toward conservative handling of the question of changing existing units and standards. Broadly speaking, the discussions were confined to two principal topics: First, the matter of fixing upon a concrete standard of e.m.f., as exemplified by the Clark and Weston normal cells, or of displacing both in favor of the silver voltameter standard; and secondly, the question of rationalizing units in general.

The American speakers were in favor of retaining only the standard cell as the basis of comparison, because of the ease with which it can be handled, and because of recently discovered methods for obtaining pure ingredients; the foreign delegates, on the other hand, seemed disposed to hold to the silver voltameter. With regard to the general system of units, it seemed to be the consensus of opinion that it is too late for any radical change, and that it is best to "let well enough alone."

It was generally agreed that the time is not ripe for recommending legal changes in the accepted value of the e.m.f. of the Clark cell; nor for any action tending toward the replacement of this cell by the Weston Cadmium (normal) cell.

At the session of Thursday, September 15, Professor S. Arrhenius presided. The first paper presented was on "The Electric Arc," by Professor C. D. Child. The paper presents an explanation of the phenomena of the arc based on the electron theory. The irons are produced: First, either within the cathode, because of its high temperature, or at the surface of the cathode by the bombardment of the positive ions; second, in the gas, by the impact of the atoms on the negative ions at high temperature; and third, at the surface of the anode, by the impact of negative ions. The electric force must be sufficiently great so that the energy transformed will produce the required high temperature. The explanation contradicts the theory that the current is a flow of charged particles driven off by the electrodes, for if this were the case the arc would be opaque, due to the great number of the particles necessary to yield the actual current density.

The paper was discussed by Dr. H. T. Barnes and Mr. P. H. Thomas. In reply to questions by the former, Prof. Child stated that he believed the action at the cathode to be confined to the surface; and that the ionization of the atoms in the gas is due to the fact that the high temperature so increases their internal energy that they are almost ready to disrupt before a collision takes place.

"The Absolute Measurement of Inductance," by Dr. E. B. Rosa and Mr. F. W. Grover, was the next paper. These measurements, made at the National Bureau of Standards, were undertaken to determine whether inductance could be measured with sufficient accuracy to establish a basis for determining the ohm in absolute measure.

An alternating current of frequency, ω, was passed through a non-inductive resistance and an inductive coil connected in series. The resistance of the non-inductive part was made equal to the impedance of the coil by adjusting the former until the drop around it, as measured by an electrometer, was equal to the drop around the latter; therefore, $R = \omega L$, and hence, L could be calculated when R and ω were known.

Careful corrections were made to eliminate errors due to non-sine waves of e.m.f. and current. Both waves were determined in all cases, the irregularities in the latter being magnified, for pur-

poses of measurement, by a condenser. The frequency was kept constant within very small limits during any run by a special device, which consisted of a bridge arrangement for measuring capacity in absolute measure; thus any change in frequency caused the galvanometer needle to depart from its zero position.

The average deviations from the mean value of L were less than one part in 10,000, and these were apparently due more to the construction of the coils than to the method. The paper was discussed by Dr. Drysdale.

Prof. E. Rutherford then read a paper entitled "The Corpuscular Theory," by Prof. J. J. Thomson. The paper describes experiments made to determine whether there is the same relation between mass and weight in radium as exists in the case of ordinary substances. It has been thought that the peculiar internal conditions of radium might cause a difference in this ratio.

A small flask of aluminum foil, containing radium bromide, was suspended by a silk fiber within a vacuum tube; a piece of metal foil was pasted inside the latter around the flask of radium. The period of oscillation of the suspended system was then measured and the value of "g" calculated. Thus, using a long suspension fiber, g was found to be 981.6, while with a short fiber, $g = 982.06$. The ordinary value of g at Cambridge is 981.25, so that the differences are within the limits of error. Hence the conclusion that the ratio of weight to mass of radium is the same as in other bodies.

The final paper of the session, "Coherer Action," by Dr. K. E. Guthe, was read in abstract by A. S. McAllister.

The first paper of the final session on Friday, September 16, was entitled "The State of Our Knowledge Regarding the Earth's Magnetism and Recent Remarkable Magnetic Storms," the author being Dr. L. A. Bauer. The author states that the earth's magnetism is perhaps partly electromagnetic and partly purely magnetic; if the former is the cause, the earth currents must be within the earth and flowing from east to west. Calculations of secular variation of the earth's magnetism, based on this latter assumption, agree well with observed variations between 1842 and 1885. The writer has computed the magnetic moment of the earth at several times between 1840 and 1885, and finds a loss of 1.6 per cent. in about 46 years. Since the line integral of magnetic force around a parallel of latitude is not zero, there must be vertical currents entering or leaving the earth. These have been calculated by the use of declination charts, and average about 30 milliamperes per square kilometer. The direction of these currents was found to agree closely with the known air currents. In localities of high barometric pressure the electric currents are downward, and vice versa. It was also pointed out that the anomalous distribution of magnetism follows temperature variation, being intense in cold places and weak in warmer regions, thus resembling ordinary magnets.

In the discussion which followed, Messrs. Glazebrook, Steinmetz and Bauer participated. The discussion turned mainly to the question of protecting magnetic observatories from disturbances by leakage currents from power circuits.

Dr. Svante Arrhenius then presented his paper "On the Relation Between the Sun's Rays and Electromagnetic Disturbances on the Earth." The theory is advanced that negatively charged particles are repelled from the sun by the pressure of radiation. It is shown that a globule of radius 0.08 μ will be repelled with a force about ten times greater than that of gravitational attraction. Irregularities in the emission of these particles, caused by solar outbursts, sun-spots, etc., produce corresponding magnetic disturbances on the earth, a time lag of roughly 45 hours intervening. This can be accounted for by assuming that the globules are of the nature of hydrocarbons, which are repelled about 2½ times more than they are attracted.

A simple mathematical calculation shows that such charged particles in space will be attracted by the sun if they are within a distance of 0.63 light-years. Reasons are advanced for assuming the sun to be positively charged; the amount of the charge remains constant because the repulsion of negative particles is compensated by the attraction of others from the vast space mentioned above. Calculations indicate a probable charge on the sun capable of producing a potential gradient of 1.6 electrostatic units per centimeter.

The discussion was participated in by Rutherford, Steinmetz and Arrhenius. It was brought out that the smallness of the effects on the earth's magnetism due to solar disturbances might be attributed to the relatively small total changes occurring; and that the total number of charged particles reaching the earth was small; calculations showing the total mass of the sun's corona is very small.

The discussion was followed by a paper on "Radioactive Change," by Prof. E. Rutherford, which had the form of a report of further work on transition stages of radium. In previous communications the author his discussed stages A. B and C. He now finds that radium C can be both chemically and thermally separated into two other substances which he calls radium D and E. Of these, radium D emits only β rays, and radium E only α rays. Radium D has, apparently, a period of 40 years, while radium E has a period of one year, so that each of these should be very much more active, in a radioactive sense, than pure radium.

Prof. A. G. Webster followed with a paper entitled "Report on Recent Developments in Electrical Theory." This is a long mathematical paper, not capable of being abstracted, and dealing with Lorentz's electron theory.

Electrochemistry at the International Electrical Congress.

Several pages of the last issue of ELECTRICAL WORLD AND ENGINEER were devoted to the report of the International Electrical Congress and to the section on electrochemistry a large share of space was given. We are now able to present a further report of items not then covered.

MONDAY SESSION.

Immediately after the inaugural general meeting of the Congress, Section C was organized with the following officers: Prof. Henry S. Carhart, chairman, and Mr. Carl Hering, secretary. The only paper presented at this session was that of Prof. Theo. William Richards (Harvard University) on the relation of the hypothesis of compressible atoms to electrochemistry. In the absence of the author it was read by Dr. G. W. Patterson. An abstract of this paper was given on page 466 of our last issue. It was discussed very briefly by Prof. Carhart and Prof. Patterson with respect to the application of Richards' hypothesis to the Gibbs-Helmholtz equation.

TUESDAY SESSION.

In the absence of the president and secretary of the section during this session, Dr. W. D. Bancroft acted as chairman and Mr. S. S. Sadtler as secretary. The first paper was presented by Mr. J. Sigfrid Edstrom, on electric extraction of nitrogen from the air. The paper dealt with the methods of Prof. C. Birkeland and Mr. S. Eyde, of Christiania, based on the well-known fact that the electric current in the arc and with it the arc itself, can be deflected by a magnetic field, the deflection being at a right angle to the lines of force. When an arc is deviated in this way, it is broken after a short interval and another arc is formed. It is possible to make the speed of the arc so rapid and the formation of the new arc so instantaneous that several thousand arcs may be formed per second. In the practical form of the ovens, used by the inventors, however, only some hundred arcs per second are used. If the arc is fed by direct current and the magnetic field by single-phase alternating current, the arcs vibrate in a plane, at both sides of the electrodes. The arcs are formed, carried outward and extinguished so rapidly that to the eye they appear as a disc of arcs. The efficiency obtained in practice is 900 kilograms HNO_3 per kw-year. The air coming from the oven contains about 2 or 3 per cent of NO; in order to be utilized it must be transformed into NO_2. This is done in a reaction tank of thin sheet iron enamelled on its inner side. The process is stated to have been put into actual operation and compounds of nitrogen have been manufactured.

In the discussion Prof. C. F. Burgess remarked that the figures given in the paper indicate a rather high efficiency, if 1 kw-year yields 900 kg of 100 per cent. HNO_3. Mr. Edstrom replied that this is the case, but this energy is the energy consumed in the arc itself only; there are losses of energy in other parts of the apparatus, moreover the power is not the only item of expense. Dr. E. F. Roeber suggested the use of a rotary field for deviating the arc, which is fed with direct current; then the arcs would cover a cylindrical volume rather than a disc and it would seem that a greater amount of air could possibly be acted upon. Mr. Edstrom said that no experiments had been made in this direction.

A paper was then presented by Dr. Wilder D. Bancroft (Cornell University) on the chemistry of electroplating, an abstract of which was given on page 469 of our last issue. The discussion was opened by Dr. E. F. Kern, who read a long communication by Mr. A. G. Betts, criticising several of Dr. Bancroft's generalizations. Mr. Betts thinks that these generalizations are not based on sufficient experimental evidence; he thinks Glaser's results on lead deposition are not trustworthy and no general conclusions should be based on the same. Mr. Betts says there are two causes for the failure of an electro-deposit. First, it may fail from being slimy, grading off into being soft, unsound and weak; this is stated to be due to the co-deposition of foreign conducting particles, in general caused by the presence in the solution of a small quantity of some metal of less chemical affinity than the metal being deposited. A second cause of failure is the growth of a deposit toward the anode; the more elevated a particular point is from the cathode surface, the more rapid is its growth. Dr. Louis Kahlenberg emphasized that the chemical make-up of the solution is the vital factor. Prof. C. F. Burgess said whether one calls a deposit good or bad depends much upon the standpoint whether one is a refiner or an electroplater. In his reply, Prof. Bancroft said that the object of his paper was to give some distinct generalizations which can be tested by experiment and which can be proven to be either right or wrong.

Prof. F. Haber's and Dr. L. Bruner's paper on "The Carbon Cell" was then read, in absence of the authors, by Prof. C. F. Burgess. An abstract of this paper was given on page 468 of our last issue. The discussion was opened by the reading of a communication by Mr. C. J. Reed, who thought that the authors had not given sufficient proof for their theory that the Jacques cell is essentially an oxygen-hydrogen gas cell. He believes that Ostwald's explanation of the chemical action in the cell is the correct one. He maintains his former position that the cell is essentially a thermo-electric one, heat supplied from the outside being the chief source of the electrical energy generated. Some brief remarks were made by Prof. Bancroft and Prof. Kahlenberg.

The next paper was presented by Dr. Louis Kahlenberg (University of Wisconsin) on "The Electrochemical Series of the Metals." An abstract of this paper was printed on page 469 of our last issue. In the discussion of the paper, Prof. W. D. Bancroft remarked that some of Dr. Kahlenberg's results throw doubt on the correctness of some silent suppositions made in the derivation of some of the fundamental laws of physical chemistry, and thereby on our present methods of determining molecular weights in solutions. Dr. H. E. Patten gave an outline of the programme of the work to be done in continuation of the researches dealt with in Dr. Kahlenberg's paper.

Mr. A. G. Betts' and Dr. E. F. Kern's paper on the "Lead Voltameter" was then read by Dr. Kern. An abstract of this paper was given on page 469 of our last issue. There was no discussion.

The last paper of the session was Mr. James Swinburne's (London) paper on "Chlorine in Metallurgy." An abstract of this paper was printed on page 469 of our last issue. In the brief discussion which followed, Dr. W. D. Bancroft referred to the troubles which electrolytic alkali manufacturers have with the chlorine generated since there is an overproduction of bleaching powder. Mr. S. S. Sadtler said that Mr. Swinburne's scheme of treating complex sulphide ores is of great simplicity on paper, but on a large scale there should be many complications.

At a special meeting of Section C held in the Library Hall of the Administration Building in the World's Fair, Dr. Hans Goldschmidt lectured on aluminothermics as noted last week and made a great number of very effective and interesting experiments. He spoke mainly on the uses of thermit for welding rails and tubes and for repairing broken castings, but mentioned also two quite recent new applications. One is the use of his slag (aluminum oxide) which when treated with a suitable binding material can be formed and used for chemical dishes, vessels, etc.; it has practically a zero coefficient of expansion. Dr. Goldschmidt heated such a vessel to red heat and then poured cold water on it; the vessel did not crack. The other new application is the use of a thermit cartridge in a very handy stove, for quickly warming food and drinks in the open air, without a flame; this is intended for use on outpost duty in war. There was no meeting of Section C on Wednesday.

THURSDAY SESSION.

The first paper of the session was presented by Dr. K. E. Guthe (National Bureau of Standards, Washington), on the "Silver Voltameter," an abstract of which was given on page 476 of our last issue. At the conclusion of his paper Dr. Guthe emphasized that as far as accuracy and possibility of reproducing the instrument are concerned, the silver voltameter is as good as a standard cell; yet the latter may win out in the end for practical reasons. In the discussion Dr. Glazebrook gave an outline of the work which has been done in the British National Laboratory. Prof. W. D. Bancroft suggested to try a cathode inside a porous cup and the use of a rotating cathode. Mr. S. S. Sadtler suggested the use of silver nitrate as electrolyte. Prof. Carhart spoke of his early experiments in connection with this subject.

A paper, entitled "A Study of the Materials Used in Standard Cells and Their Preparation," of which Prof. Henry S. Carhart and Prof. Geo. A. Hulett (University of Michigan) are joint authors, was then presented by Prof. Carhart. An abstract of this paper was published on page 473 of our last issue. Dr. Glazebrook again spoke of tests made in the British National Laboratory in which much the same results had been obtained. They are now experimenting with three methods of preparing mercurous sulphate which lead to practically the same results; one of these is Carhart's method. Prof. Bancroft pointed out that these investigations have given us a strictly reversible electrode; the calomel electrode is constantly used as a reversible electrode, but it is doubtful whether it comes up to the requirements.

Dr. Paul L. T. Héroult (La Praz, France) then presented a paper on "The Use of the Electric Furnace in the Metallurgy of Iron and Steel." He first gave a review of his work in making ferro-alloys and in reducing iron from ores, and discussed especially two methods of utilizing the electrical energy to the best advantage. He expressed the view that the electric furnace for the reduction of iron ores is applicable only under certain conditions and is not supposed to supersede the blast furnace except where electric energy is very cheap. He then discussed his electric steel process which is in use at La Praz, France, and at Kortfors, Sweden. He produces there steel of a quality equal to and superior to the best crucible cast steel, from scrap. He made the claim that at a cost not exceeding half a dollar a ton, he can make out of any steel delivered in the molten state (for instance, as tapped out of a Siemens furnace or a Bessemer converter), a metal of any desired composition, containing less than 0.01 sulphur and 0.01 phosphorus. Dr. Héroult did not predict that the electric furnace process will supersede the old metallurgy, "but it will and must cause a revolution so far as the quantity of the metal used in the industries is concerned."

In the discussion which followed, Dr. J. W. Richards spoke in highly complimentary terms of Dr. Héroult's work and discussed the various special uses to which the electric furnace may be put in iron and steel metallurgy. Mr. W. McA. Johnson said that this is another example of the general rule that the electric current is most useful in metallurgy for the finishing touches.

Dr. A. E. Kennelly's and Mr. S. E. Whitney's (Harvard University) paper on the "Present Status of the Edison Storage Battery" was then read by Mr. Whitney. An abstract of this paper was given on page 473 of our last issue. In the discussion which followed, Prof. Burgess gave the results of some tests made by two of his students in his laboratory; he called attention to the fact that, in some cases, gas is liberated during discharge. Dr. A. E. Kennelly pointed out that in this cell an approach has been accomplished to the steel structure in dynamo construction, with respect to the number of watts per pound. We have here a steel structure which resembles the steel structure of machines devoid of electrolyte. The efficiency of the cell is low, but the cell is fool-proof and will stand the worst treatment.

Dr. J. W. Richards (Lehigh University) then presented his paper on "Electrolytic Conduction," an abstract of which was published on page 473 of our last issue. In the discussion Messrs, Hering, Roeber, Patten, Bancroft and Kahlenberg participated and pointed out that the one experiment given by Dr. Richards as support of his theory would not be sufficient proof.

Prof. R. Lorenz' (Institute of Technology, Zurich, Switzerland) paper on the "Electrolysis of Fused Salts" was then read in abstract by Dr. E. F. Roeber. Prof. Lorenz discusses the peculiar phenomena which are characteristic for the electrolysis of fused salts and deals with two examples at some length. In the case of the electrolysis of fused lead chloride we have the phenomenon of the dissolution of the cathodically deposited lead in the fused salt, with the formation of a "metallic mist." In the case of the elec-

trolysis of fused zinc chloride there is not only formation of mist, but there are troubles due to basicity; it is necessary to carefully remove all water. Faraday's law is fulfilled if special precautions are taken to prevent the formation of the metallic mist. If the metallic mist reaches the anode, it causes depolarization and regeneration of the electrolyzed salt. There is a complete parallelism between the phenomena of ampere-hour efficiency and polarization. The paper was not discussed.

The final paper of the session was Prof. W. Ostwald's (University of Leipzig, Germany) paper on "Electrolysis and Catalysis." In the absence of the author, it was read in abstract by Prof. W. D. Bancroft. Prof. Ostwald points out that if at an electrode several reactions are possible, and if the voltage at the terminals is gradually raised, one reaction after the other will set in, as soon as the minimum voltage, required for its start, is reached. By varying the concentration of a certain kind of ions it is possible to some extent to vary the place of its reaction in the voltage series. Of greater importance may, however, be the use of catalytic agents. A positive or catalyzer is a substance which increases or diminishes respectively the speed of a certain reaction. By applying such catalyzers judiciously, it is possible to bring the one reaction which is wanted to the front and to practically suppress the others which are otherwise possible. There was no discussion.

FRIDAY SESSION.

The Thursday session of Section C finished the work of Section C of the Congress, and the Friday session was, in fact, an independent meeting of the American Electrochemical Society, to which, however, the members of the German Bunsen Society and the British Faraday Society as well as all members of the International Electrical Congress had been invited.

At the opening of the session Dr. Hans Goldschmidt (Essen-Ruhr, Germany) presented the good wishes of the German Bunsen Society to the meeting and Dr. J. W. Richards spoke for the British Faraday Society.

The first paper of the session was presented by Dr. H. E. Patten (University of Wisconsin) on "An Analytical Study of the Deposition of Aluminum from Ethyl Bromide Solutions." The paper was chiefly of chemical interest. While it is possible to get an aluminum deposit in this way, yet the author concludes that aluminum bromide dissolved in ethyl bromide lacks the requirements of a commercial plating solution for the deposition of aluminum. In the discussion which followed, Prof. W. D. Bancroft spoke of the uncertainty of Ostwald's zero of potential, while Prof. J. W. Richards was interested in the idea of using a non-oxygen containing electrolyte for the deposition of aluminum.

Prof. W. D. Bancroft (Cornell University) then read a paper on "The Aluminum Rectifier." He has used phosphoric acid as electrolyte. When the current is gradually increased, the current efficiency starts very low, about 50 per cent., and is later on pretty nearly constant, about 75 or 80 per cent. The power factor starts with 35 per cent. and goes up to 90 per cent. with increasing current. The voltage efficiency is low, going down to 30 per cent.

In the discussion of this paper Prof. Burgess referred to his investigation in which he attempted to give an analysis of the losses in the rectifier. Prof. Bancroft expressed the belief that Burgess' valve theory is not the correct explanation; he considers the valves as a source of inefficiency of the film, while Burgess believes that the whole current passes through these perforations.

Mr. W. McA. Johnson (La Harpe, Kansas) then presented a paper on "Some Aspects of Applied Electrochemistry." Mr. Johnson remarked that applied science amalgamates two studies, economics and natural science. When starting up any new proposition that is to compete with an old and established process, it is of prime importance to know the defects and good points of the old business. Thus electrometallurgical methods have attacked the iron and steel industries most successfully at their weakest point, i. e., the manufacture of crucible steel. Not only the present status of the old process should be known, but also a keen forecast should be made as to what improvements the old process is susceptible of. Any new process should have a good margin over any possible future cost of production by the improved old process. In metallurgy usually a combination of reactions, each suited for its own duty, produces the cheapest metal. There are generally roughing reactions, intermediate reactions and finishing reactions. It is in connection with the latter that electrochemical methods should prove most valuable. According to the modern view of esthetics, a thing is considered beautiful by the human mind because it commotes in it the sense of efficiency, i. e., ability to do its duty well. So, a beautiful metallurgical process is one that does the work well and cheaply. The paper was not discussed.

A paper by Mr. F. A. J. FitzGerald (Niagara Falls, N. Y.) on "The Use of Carbon for the Study of the Temperature in the Electric Furnace" was then presented. In the absence of the author it was read by Dr. J. W. Richards. The method is based on the fact that if a piece of amorphous carbon is subjected to different temperatures it changes its physical and chemical properties. By placing different pieces of amorphorus carbon at different points of an electric furnace and by afterwards determining the changes which it has undergone, it is possible to estimate the temperatures at the different points where the carbons were located. It is especially useful to determine the change of density. The author describes various experiments in which he applied this method; in one case it was found in this way that the temperature inside of an electrical furnace was not at all uniform on account of insufficient heat insulation. There was no discussion.

The last paper of the session was presented by Prof. W. D. Bancroft (Cornell University) on "Electrolytic Separation of Cobalt and Nickel." The method described is chiefly of chemical interest and is useful for the preparation of pure cobalt and nickel salts, although it requires considerable time.

Prof. Burgess then proposed a vote of thanks to the organization committee of International Electrical Congress and the meeting adjourned.

Electric Light and Distribution Before the International Electrical Congress.

THE papers read before the Section on Electric Light and Distribution, at the International Electrical Congress were abstracted in the last issue of ELECTRICAL WORLD AND ENGINEER and accompanied by brief telegraphic notes of the discussions. Below is given a fuller report of the discussion of the various papers, which discussion developed many interesting facts.

Section E began its sessions on Monday morning with the reading of an interesting paper on "Improvements in Electrolytic Meters," by Mr. Arthur Wright, the originator of the well-known Wright demand meter system; in the absence of the author the paper was read by Mr. J. R. Dick. There was no discussion of the paper, and the section passed on to the reading of Mr. Etienne de Fodor's paper on "Rates for Electricity Supply." (For abstract see p. 467, Sept. 17.)

In the discussion which ensued, Mr. F. E. Gripper said that he did not agree with the author's idea of raising the rates for power service and lowering those for lighting to equality; he thought the proper result to strive for was the lowering of power rates to such a degree as to increase the service sufficiently to make the lighting load small in comparison with the power load; then it would not be so important to get high rates for lighting, and those rates could be lowered. Arthur Williams pointed out the fact that the difference between rates for lighting and those for power is due chiefly to the difference in load factors of these classes of service; the lighting load shows the familiar sharp peak, while an ordinary power load does not—the average load is a much greater percentage of the maximum than in the case of a lighting load. Col. R. E. Crompton agreed with Mr. Gripper and also agreed with the author that the introduction of a unit scale of rates for lighting and power service could be accomplished only by decreasing the rates for lighting currents; the companies in England that charge the lowest rates, he said, pay the best dividends. The average rates there are 10 cents per kilowatt-hour for lighting and 5 cents for power current. Mr. R. Hammond advocated rates based on a high charge for the first hour and low price for succeeding hours; the rates in a certain London plant were 14 cents for the first hour for lighting current and 8 cents for power current; for all succeeding hours, 2 cents for each class of service. He thought that Mr. de Fodor overlooked the fact that the cost of producing current includes more than the mere expense for fuel, station employes, etc., which varies roughly with the output of the station; the cost of producing a kilowatt-hour was in many cases doubled by interest and other fixed charges. Mr. Louis Ferguson agreed with Mr. Hammond's remarks concerning cost of production, and with Mr. Williams

as to the effect of load factor upon rates; the power load factor is so much higher than that of the lighting service that a much lower rate is practical for a given number of kilowatt-hours. Mr. Torchio elaborated the argument based on differences in load factors, illustrating his remarks by diagram which showed the general characteristics of lighting and power load curves. Mr. Dick pointed out that simplicity of tariff rates does not necessarily give the best results, although desirable as far as it may be practicable. An analysis of operating conditions and detail results is necessary for intelligent management. He thought it impracticable to have a single scale of rates for both lighting and power current.

The next paper presented was one by Mr. George N. Eastman, delegate from the National Electric Light Association, on the subject of "The Protection and Control of Large High-Tension Alternating-Current Distributing Systems," which was abstracted last week, p. 467.

Mr. W. C. L. Eglin said that perhaps the trouble that central station engineers fear worst is interferences in underground feeders connecting the station with a sub-station. These troubles should be located just as soon as they develop, and, if possible, before they actually manifest themselves, when the cable is about to break down; from Mr. Eastman's paper, it seemed that this was the point to which he and his colleagues were devoting most of their attention. The general description, of course, applied to most central stations in this country, and he would like to hear how it compared with the practice in other countries. There was, however, no further discussion of the paper, and the section passed on to the reading of a paper by Mr. Eglin, on "Rotary Converters and Motor-Generator Sets."

The paper was discussed briefly by Col. R. E. B. Crompton, and Messrs. Philip Torchio, J. E. Tilney and W. C. L. Eglin; the discussion brought out the facts that in England a large system using motor-generators shows an over-all efficiency from generator to consumer of 70 per cent. to 75 per cent.; that starting the motor-generators on the alternating-current side is accomplished with about 60 per cent. of the full load running current, and that in this country the preferred practice is to start on the direct-current side, which requires only about 25 per cent. of the full load running current.

The first paper read at Tuesday's session was that of Mr. Carl Rodenbourg's, on "The Prussian System of Electric Train Lighting," abstracted last week, p. 470.

In the discussion of the paper, Col. Crompton said that the idea that the Pintsch system is dangerous dates back 22 years, and is without foundation; as a matter of fact, it is so safe and simple that it has been extremely difficult to get an electric lighting system to compete with it. He had come to the conclusion that the best way to provide electric lighting on trains is to use accumulators on each car, set into a compartment under the car and replaced at occasional stations with fresh batteries; this dispensed with machinery, automatic switches and other complications. Prof. George F. Sever outlined briefly the two general classes of train-lighting systems in use in this country: the one in which a dynamo is driven from the car axle and storage cells are employed in conjunction with it, to take care of fluctuations, stops, etc., and the other involving the use of a dynamo driven by a small engine and located in the baggage car, no batteries being used. The former, he stated, appeared to have preference.

The second paper was an admirable discussion by Signor E. Jona, delegate of the Italian Electrotechnical Association, on "Insulating Material in High-Tension Cables." The paper contains so much mathematical treatment that a full abstract is impracticable.

The author's conclusions were as follows: Every insulating material has a limit of resistance to puncture; when the maximum e.m.f. per unit of thickness is exceeded, increasing the thickness of the material will not prevent a break-down. The stress is greatest nearest the conductor, so that adding insulating material on the outside does not reduce proportionately the stress on the inner layer; hence an enormous increase in thickness of insulation would be required in order to raise appreciably the break-down point of the covering. In order to obtain the highest resistance to puncture, the insulating covering of cables should be applied in layers of graded specific inductive capacity, the material having the highest specific inductive capacity being next the conductor, and so on, to correspond to the potential stress gradient, which, as above stated, is greatest near the conductor.

The subject of distribution systems for central stations was covered very fully by three papers which were read in the order named, and discussed jointly: "Distributing Systems from the Standpoint of Theory and Practice," by Mr. Philip Torchio; "The Direct-Current Distributing Systems of American Cities," by Mr. Alex. Dow, and "The Superiority of Alternating Current for the Supply of Current to Large Cities," by Dr. Gotthold Stern, all of which papers appeared in abstract in last week's issue.

Mr. Townsend Wolcott stated that all the cable insulation he has tested runs over 1,000 megohms per mile, with the cable immersed in water, so that the maximum leakage through such insulation under 1,000 volts would amount to an ampere-hour in 1,000,000 hours, which would be equivalent to 100 years; Dr. Stern's fears concerning electrolysis in the covering of direct-current cables subjected to high voltages, therefore, seemed unfounded.

Referring to Mr. Torchio's paper, Col. Crompton said that the operating conditions in England were different from those in this country. The largest English stations have found it advisable to adopt high-voltage incandescent lamps (200-240 volts) and to double the old voltage of their distribution systems. The lamp makers had said it was impossible to produce efficient high-voltage lamps, but the insistent demand for them had caused them to be made; the high-voltage lamps were of as good efficiency as those for 110 volts and thereabouts. This condition practically wipes out a large part of Mr. Torchio's argument so far as England is concerned, and transfers his No. 17 hypothetical equipment from the bottom of the list to the top. Most English systems are built on this basis, except that they use motor-generators instead of rotary converters; they are now just beginning to try converters, however, being encouraged by the reports of results obtained in America with them. Mr. Torchio's method of basing his argument on a hypothetical town was wrong; no such town existed as that which was assumed in the paper. He himself had prepared at great expense exhaustive estimates and figures based on an "ideal" town, but he had never got his money out of them. Col. Crompton also advocated strongly the use of storage batteries, and stated that responsible companies in England were putting out batteries on a guarantee of 6 per cent. maintenance.

Mr. Hammond, who has spent a great deal of time during the past thirteen years analyzing central station records in England, where all records must be filed with the Government, said that he preferred either straight alternating or straight direct current throughout a plant; for distances of 2½ miles or under, he would install a direct-current plant of "double" voltage (440 to 480 volts across outside wires, three-wire); for greater distances, a straight alternating-current plant. Mr. Louis Ferguson disagreed with this policy; he thought by combining alternating-current transmission with direct-current distribution the full advantages of both systems were made available and their chief disadvantages avoided. Elevator motors, he said, referring particularly to Dr. Stern's advocacy of induction motors, must be direct-current for high car speeds; at 250 feet a minute or over, the induction motor was impossible.

Mr. Arthur Williams pointed out that lighting standards in England were not quite so high as here, which possibly accounts for the indifference to high-economy lamps. The American central stations take the ground that they sell *light* as distinguished from selling merely current, and it is not expedient to allow customers to purchase their own lamps unrestricted. Mr. Torchio, closing the discussion, said that the conditions described in his paper are not "ideal," but are to be found in most American cities of smaller size; his method, therefore, was correctly founded from the practical view-point. Referring to high-voltage lamp efficiency, he said that four or five years ago such lamps in England ran as high as 7 watts per candle, and he thought Col. Crompton must have in mind 3.5-watt lamps in saying that high-voltage lamps were now as efficient as those for the ordinary voltages.

The final paper of the day's session was Mr. Louis A. Ferguson's, on "Underground Construction," which was printed in abstract last week. The paper was discussed by Messrs. Arthur Williams, Taite, Crompton and Ferguson. Col. Crompton thought the method of making connection between overhead and underground lines, which was described in the paper, was inadequate. In Calcutta he had had great trouble from inductive discharges of a surging character at this point and had found it advisable to provide substantial hollow pillars to contain the connector tablets, and to furnish arresters and hand switches between the overhead and underground circuits. In London, he had had to provide much better ventilation at manholes than was described in the paper,

in order to guard against accidents due to gases. He said that in certain parts of his company's system distribution he used bare strap copper conductors, mounted on porcelain insulators, the latter being located in manholes at short intervals. The conductors were insulated from the duct walls only by air. In seventeen years the maintenance had averaged only one-third of 1 per cent.

There was no session of Section E on Wednesday, this being "Electricity Day" at the World's Fair, when a joint meeting of the American Institute of Electrical Engineers and British Institution of Electrical Engineers was held at Festival Hall, in the Exposition grounds. At this convention, a paper was read by Col. Crompton on "Standardization of Dynamo Electric Machinery," which paper was discussed at Thursday's session of Sections B and E jointly. The first paper taken up on Thursday was one of Prof. Clarence Feldman and Mr. Josef Herzog on "The Distribution of Voltage and Current in Closed Conducting Networks." This paper was abstracted on page 474 of last week's issue.

The paper was discussed briefly by Messrs. Lieb, Crompton, Kennelly and Junkersfeld. Messrs. Lieb and Crompton said that their respective companies had started out with the plan of laying out a model of the distributing system and carefully computing the distribution of the load on the mains, and therefrom, the size of the mains, but this had been later found unnecessary. The better plan is to lay down uniform standard-sized mains with a view to the probable increase in load in the immediate future, and to start with feeders sufficient to supply the mains, adding feeders according to the distribution of the load that developed in actual practice; in this policy Mr. Junkersfeld concurred. Dr. Kennelly said that the paper conferred the advantage of simplifying the calculation of mains and supplied a physical means of working out a mathematical problem.

"The Electric Arc" was the title of the next paper, which was read by Dr. Charles P. Steinmetz. In it the author presented briefly the characteristics of arcs between different kinds of electrodes and described some extremely interesting investigations of the mercury arc stream and the magnetite or flaming arc which had been carried on in the General Electric Company's laboratory. The familiar arc between carbon electrodes is not a typical arc; carbon has been used so largely probably because of its ready volatilization and the fact that it is the only material that will maintain an alternating-current arc at a relatively low difference of potential. The typical open arc is that between iron and copper or their oxides; the typical vacuum arc is the mercury arc stream. Magnetite electrodes and the mercury arc stream both act as rectifiers under certain conditions. In order to produce a true alternating-current arc stream in mercury vapor, 9,000 volts are required; at lower voltages, every other half wave is suppressed, the current being unidirectional. The range of rectification is that between the direct-current e.m.f. that will maintain the stream or arc and the alternating e.m.f. that will strike across the gap when no arc exists.

In the absence of the author, Dr. Louis Bell read a paper by Prof. A. Blondel on "Impregnated Arc Lamp Carbons," in which the author reviewed the development of the Nernst lamp and the mercury arc, and led up to the different classes of electric arcs, the characteristics of which he described. He discussed at some length the investigations that had been made with mixed electrodes—carbon combined with various salts—and summed up the salient characteristics of arcs between electrodes of mineralized carbon, hollow and cored carbon, and his own form of electrode, consisting of mineralized carbon within a thin sheath of pure carbon. The following table of comparisons was given:

Kind of arc.	Watts.	Mean hemispherical candle-power.
Ordinary open arc between carbons	495	700
Enclosed arc between carbons	768	329
Steinmetz's Magnetite arc	385	400
Bremer arc, inclined carbons; 9 amperes	495	4814
Blondel carbons; 9 amperes	500	4800

In the discussion of Dr. Blondel's paper, Mr. Lieb mentioned trials of the Blondel lamp in comparison with enclosed arcs, in which a 200-watt, 3-ampere Blondel lamp showed better diffusion and effective illumination than a 500-watt enclosed-arc lamp using the usual type of carbon electrodes. Dr. J. P. Jackson said that an equipment of magnetite arcs in Harrisburg showed equal illumination with 9.6-ampere open arcs at distances 20 per cent. to 30 per cent. farther away from the lamp; the magnetite lamps take 320 watts. Prof. E. L. Nichols said that comparison between artificial illuminants of the types now being developed was impossible by means of ordinary photometry on account of the selective radiation involved, and said that some other means of comparison must be devised before the relative merits could be determined. Dr. Steinmetz pointed out that high efficiency alone is not the commercial criterion; long life of electrodes and other operative conditions modified the matter very greatly. The titanium arc shows the highest efficiency of any, requiring about 0.15 watt per candle, but it does not meet commercial requirements.

Section E then joined Section B in the discussion of Col. Crompton's paper on standardization. The old question of frequency was the chief topic, the English standard proposed by Col. Crompton being 50 cycles, while the American standard of that order of magnitude is 60 cycles. The concensus of opinion was to the effect that there is too large an amount of 60-cycle apparatus in use to permit changing to 50 cycles in America; that as there were several frequencies in use in Europe it would perhaps be possible to get 60 cycles adopted there, but that the matter is chiefly one of commercial importance, so that engineering conclusions would have little weight. Profs. Steinmetz, Ascoli and Crocker, Col. Crompton, and Messrs. Lieb, Scott, Gray (president British Institute) and Glazebrook participated in the discussion.

Prof. L. Lombardi then read his paper on "Stroboscopic Observations of the Arc," which it is impracticable to abstract on account of the large number of photographs used to illustrate, and necessary to an understanding of, the paper; these were not available for reproduction. In discussing the paper, Dr. Steinmetz said that the observations of Prof. Lombardi bore out completely his own deductions from investigations recently made. He also pointed out that the mercury arc stream acts as a rectifier of alternating current between 6,000 and 9,000 volts, even with symmetrical electrodes; the direction of the rectified current is purely accidental, he said, depending on which half wave the arc stream happened to start with, but after starting, it maintained the current absolutely unidirectional.

Prof. E. L. Nichols' paper on "Standards of Light" was read by title, which was abstracted last week, p. 475. There was no discussion of it.

The session of Friday opened with the reading of a paper by Mr. Gerhard Goettling, delegate of the Association of Edison Illuminating Companies, on the subject of "Storage Batteries as an Adjunct to Central Station Equipment," an abstract of which appeared last week, p. 476.

The paper was discussed briefly by Messrs. Crompton, Lieb, Hammond, Junkersfeld, Tilney and Goettling. Col. Crompton pointed out that the life of a battery was determined by the life of the end-cells, and thought that regulation by means of a reversible booster was preferable to the use of end-cell switches on that account; he described in some detail the arrangement made in England for guaranteeing battery maintenance to stations purchasing batteries. Mr. Lieb said that with the modern system of alternating-current generators, high-tension transmission and converting sub-stations, it was absolutely necessary to use batteries as auxiliaries in order to insure continuous service under all conditions. Mr. Hammond explained that the maintenance contracts in England covered the care of tanks, plates and everything else, except the flooring under the batteries.

In the absence of the author, Mr. Henry Noel Potter's paper on "Nernst Lamps" was read by Mr. Percy M. Thomas. The author reviewed the development of the Nernst lamp in Europe and this country, and pointed out the difference between the European and American practices. He also briefly explained the characteristics of Nernst lamp glowers, ballast resistances and heaters, and described in detail the present American practice in the construction of these lamps.

The discussion of the paper, which was participated in by Messrs. Jorge Newbery, Hammond, George Wilkinson, A. C. F. Webb and Arthur Williams, did not bring out any unfamiliar points.

A group of three papers was then read, one by Mr. W. L. R. Emmet, on "The Effect of Steam Turbines on Central Station Practice"; one by Professor Rateau, entitled "Notes on Steam Turbines Operating with Fall of Velocity," and one by Mr. Francis Hodgkinson, on "Steam Turbine Performance."

Mr. Emmet in his paper presented the usual arguments in favor of the steam turbine, and also suggested that there was an excellent field for this apparatus in the use of exhaust steam from reciprocating engines, and also in operating at steam of low pressure

obtained by delivering the jacket water of gas engines to a boiler, and heating the water by means of the exhaust gas from the engines. The output of a reciprocating engine plant he claimed could probably be increased as much as 30 per cent. by the introduction of low-pressure turbines with pressure condensing facilities, and without any increase of fuel consumption or change in the boiler plant used in conjunction with gas engines in the manner stated, he thought that a similar increase in the output of the plant could be attained.

Professor Rateau's paper consisted of a mathematical analysis of different types of steam turbines, in the course of which he drew comparisons between turbines operating with a fall of steam velocity and those operating with drop of steam pressure. The former type, he said, could be designed to give low speeds, and would therefore be highly advantageous, but they were too uneconomical, showing 28 to 44 per cent. lower economy than turbines of the multicellular type operating with drop of pressure. His paper contained a diagram plotted from formulas given in the paper, and showing that the drop of velocity type gave a maximum efficiency with the bucket speed about 30 per cent. of the steam velocity, while the multicellular drop in pressure type increases in efficiency as the ratio of bucket speed to steam velocity increases. The relation between the efficiencies of the two types as shown by his diagram is as 65 to about 74 at the speed ratio corresponding to the maximum efficiency of the drop in velocity type.

Mr. Hodgkinson's paper consisted chiefly of tabulated results of a large number of tests of recently built turbines of the Westinghouse-Parsons type, most of which were also given graphically by means of diagrams. The author explained briefly the general principle of the Westinghouse-Parsons type of turbine, and in course of which he brought out the point that three barrel diameters were used merely for mechanical convenience; if only one diameter were used, the valves nearest the steam inlet would have to be unmechanically small, or else those through which the steam passed last before exhausting would have to be unmanageably large. He also stated that each inch of vacuum beyond 25 inches will increase the economy of the Westinghouse-Parsons type of turbine by about 3 per cent to 5 per cent.

A paper by Mr. Caryl D. Haskins on "A Study of Integrating Electric Meters," and one by Mr. George R. Green, on "American Meter Practice," were next read and discussed jointly. Mr. Haskins' paper consisted of brief descriptions of the various types of meters, namely: Electrolytic, thermal, clock, relay, variable transmission and electrodynamic, the last-named class including, of course, the well-known motor type of meter.

Mr. Green's paper was restricted to the consideration of the "Commutator and Induction Types of Motor Meters," and contained practical suggestions as to the proper selection, installation and care of meters, together with remarks concerning meter reading and tests.

In the discussion of the two papers, Mr. Dick said that in England the ampere-hour meter was used very generally, and was considered as good as the watt-hour type because the voltage fluctuations compensated each other, so that the average voltage was practically equal to the rated voltage of the circuit. He strongly favored the electrolytic type of meter, chiefly because of its simplicity and accuracy at all loads. Mr. Eglin pointed out that the ampere-hour meter even on direct-current circuits is not strictly accurate, on account of voltage variations, and it was grossly inaccurate on inductive alternating-current loads for obvious reasons. He said that, in direct-current work, a practical objection to the electrolytic meter was that the customer could not read his meter; this was one of the strong reasons for discontinuing the use of the old Edison chemical meter.

A paper by Mr. Poulsen on "Producing Continuous Electrical Oscillations," and one by Mr. Horace F. Parshall, on "The Yorkshire and Lancashire Electric Power Companies," were read by title. (The latter was abstracted on page 476, last issue.) There was no discussion.

New York State Civil Service Commission.

This Commission announces general examinations to be held October 8, 1904, including electrical engineer, State Architect's office; heating engineer, State Architect's office. Applications for these examinations must be made on or before October 3. Full particulars of the examinations and blank applications may be obtained by addressing the Chief Examiner of the Commission at Albany.

President Arnold on the Application of Electricity to Railroads.

The presidential address of Mr. Bion J. Arnold at the International Electrical Congress, September 14, was devoted to the application of electricity to steam railroads. He noted that the first important use of electric power for heavy electric railroading is credited to the Chicago World's Fair, although the City & South London Underground and the Liverpool Elevated were started at about the same time. Mr. Arnold believed that electricity will be generally used on all the main railroad terminals and ultimately on the main through lines for passenger and freight service, though he does not anticipate that it will always be adopted on the grounds of economy in operation, nor that it will come rapidly or through the voluntary acts of the owners of steam railroads, except in special instances. At first the terminals will be equipped for special reasons, due either to the voluntary act on the part of the terminal companies to effect economy in operation or to public pressure brought to bear upon the owners through an increased demand on the part of the public for better service, on the ground that the use of the steam locomotive is objectionable in our great cities.

Roads which run through populous countries will either build new roads or acquire for their own protection those electric railroads already built and operating in competition with them and utilize them as feeders to their through-line steam trains. Thus the steam railroad companies will gradually become interested in electric railways and eventually become the real owners of them. With these roads operating as feeders to the main-line system and with the terminals thus equipped and the public educated to the advantages of riding in electrically equipped cars, the next step will logically be the electrical equipment of the trunk lines between the cities already having electrical terminals. Thus a favorably located trunk line having a sufficient density of population will feel warranted in equipping electrically, and when this is once done the other roads running between the same competing points must sooner or later follow in order to hold their passenger traffic.

With the terminals and main lines equipped electrically and the desire on the part of the public for more prompt and efficient freight service resembling that which is given by the steam roads in England and on the Continent, due to the great density of population, there will be developed a great high-class freight service conducted in light, swiftly moving electric trains which can be quickly divided and distributed over all surface tracks of our smaller cities or through underground systems similar to that which is now being built in Chicago. This class of freight service would soon prove so large a part of the freight traffic of a road that the operation of the through-freight traffic by steam locomotives, though at present cheaper, would in time, as the cost of coal increases, grow less, until those roads operating an electric passenger service would utimately use electricity exclusively.

Mr. Arnold considered that the principal problem before the electric railway engineer to-day is how to make the most effective use of the high-pressure transmission and high-tension working conductor and maintain safety of operation.

The Congress Circular Tour.

The circular tour, under the auspices of the American Institute of Electrical Engineers, of the foreign engineers and members in attendance at the International Electrical Congress, was resumed on September 17, the party leaving St. Louis on a special train at 11 p. m. for Pittsburg, where it arrived late Sunday afternoon.

On Monday morning the ladies accompanying the party were met by a reception committee of ladies and were taken for a drive through the boulevards and parks in the city, after which the party returned to the Hotel Schenley for luncheon. During the afternoon the ladies were provided with special cars by the Pittsbury Railway Company and were taken through the industrial section of Pittsburg to the works of the Westinghouse Company in East Pittsburg and luncheon was served at the works.

The visiting delegates were divided into six groups and under the guidance of members of the local branch of the American Institute of Electrical Engineers were taken by chartered trolley cars to

the various industrial establishments. One party went to the Carnegie Steel Works, at Homestead, another to the Edgar Thompson Steel Works, at Bessemer, another to the factory of the Nernst Lamp Company, another to the Westinghouse Electric & Manufacturing Company's works, at East Pittsburg, another to the works of the Westinghouse Air Brake Company and of the Union Switch & Signal Company, and the sixth made a general tour of all the places, paying only a brief visit to each. At 6.30 p. m. the party reunited at the works of the Westinghouse Electric & Manufacturing Company.

Here a section of one of the largest aisles in the new east machine shop had been cleared for the occasion and served admirably as a reception room and banquet hall. Tables had been arranged in the form of a figure eight with covers laid for 400. The hall was decorated with the colors of the various nations represented and was illuminated by Bremer arc lamps, while Cooper Hewitt lamps were provided for a photograph which was taken when the guests were seated. The room was further decorated by potted plants and palms and an orchestra was stationed in the gallery.

GROUP PHOTOGRAPHED AT FESTIVAL HALL AFTER JOINT MEETING OF SECTION F, BRITISH INSTITUTION OF ELECTRICAL ENGINEERS AND AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

At 9 o'clock Mr. George Westinghouse in appropriate remarks expressed his pleasure at the opportunity of meeting and greeting the guests of the evening. Responses were made by President Gray, of the British Institution of Electrical Engineers; Prof. Ascoli, of the Italian Electrotechnical Association, and Mr. B. J. Arnold responded on behalf of the American Institute of Electrical Engineers. The genial feeling to which the occasion and felicitous speeches gave rise was manifested in the singing before parting of well-known songs. Upon rising, the guests were conducted to the railroad station near by and embarked on the special train waiting to carry them to Washington.

The party arrived at Washington early Tuesday morning, and after breakfast at the New Willard Hotel visited the new buildings of the National Bureau of Standards, which are located in an ideally isolated spot on the extreme northwestern outskirts of the city. Transportation to and from the Bureau buildings was in special cars provided by the Capital Traction Company. Arriving at the buildings, the guests inspected the apparatus thus far installed and were informed by Dr. Stratton that most of the instruments and apparatus of the greatest interest had not yet been put in place; part of it was still at the old building in the northeastern part of the city and part at the Exposition exhibit.

Leaving the Bureau, the visitors were conducted to the Capitol and thence to the new Congressional Library by members of the local entertainment committee. After inspecting these buildings, a luncheon was served in the cafe of the Library building—served "decently and in order," and thoroughly enjoyed by the guests. The party then divided into groups, each group being taken in charge by a member of the local committee and conducted to a specified point of interest or group of places. The divisions were as follows: 1, central lighting and power stations; 2, telephone central exchanges; 3, the navy yard; 4, the government printing office; 5, Mount Vernon; 6, the Treasury, White House, State, War and Navy Department, Corcoran Art Gallery; 7, Washington monument, Bureau of Printing and Engraving, Smithsonian Institution and National Museum.

The various divisions united at the New Willard at 6:30 for dinner, after which the special train left for Philadelphia, arriving there between 11 o'clock and midnight on Tuesday, September 20.

The special circular tour train left Washington Tuesday night for Philadelphia, arriving there before midnight. On Wednesday morning, the ladies were tendered a tally-ho drive out as far as the Wissa-

hickon, while the remainder of the party visited the local points of engineering and historic interest in a single body. The Philadelphia Traction and Philadelphia Electric Companies' power and lighting stations, the Baldwin Locomotive Works, the United States Mint and Independence Hall were among the places visited. All reassembled at the Bellevue-Stratford Hotel for an excellent luncheon, when Mayor Weaver delivered an informal address of welcome. After luncheon, the trip was resumed, and the party arrived at New York, somewhat tired, but in excellent spirits, Wednesday night.

Social Events of the Congress Week.

The local committees at St. Louis, as already noted in these pages last week, provided a wealth of social functions and entertainments for the International Electrical Congress. The circular tour party as well as many Eastern members going direct arrived in St. Louis Sunday, and that evening the local A. I. E. E. members held an informal reception for the newcomers at Hotel Jefferson. The local committee on arrangements consisted of H. H. Humphreys, Prof. W. E. Goldsborough, T. K. Henderson and W. A. Layman. On Monday morning, when the members of the Congress were attending the first session, the local committee provided automobiles in which to take the ladies for a ride around the city boulevards.

Monday evening the committee gave the Congress a reception at the New York State Building at the Exposition grounds.

Tuesday evening came another reception by the Associazione Elettrotecnica Italiana, at the Italian National Pavilion on the Exposition grounds. The same evening Mr. Bion J. Arnold gave a dinner, as president of the American Institute of Electrical Engineers, to the officers of, and delegates to, the Congress.

It was very appropriate that Electricity Day at the Exposition should be set during the attendance of the delegates to the International Electrical Congress. The day was celebrated September 14 and the several special events were carried out in a manner reflecting much credit on the Department of Electricity and the exhibitors in the building. Those who visited the Palace of Electricity on that day found the exhibits tastefully decorated with palms, flags and bunting. In many of the exhibits special features had been introduced. The United States Incandescent Lamp Company employed several large phonographs in explaining to visitors the processes in the manufacture of incandescent lamps being carried on in Electricity Building. In the booth of C. H. Thordarson the 500,000-volt transformer was utilized in illuminating tin foil letters spelling "Franklin."

At noon luncheon was served in the main corridor of the building by the Engineers' Club of St. Louis, to the members of the International Electrical Congress.

The Electricity Day parade formed near the north entrance to the building at 1.30 o'clock. A company of Jefferson Guards was at the head. Following were members of the Electrical Congress in automobiles.

The Bell Telephone Company of St. Louis was prominently represented in the parade. Line wagons, lunch wagons, cable wagons, and other vehicles used in construction work were in the line of march.

The reception tendered in the evening by the exhibitors of the building to their friends and to the members of the Electrical Congress was a most enjoyable affair. The building was open only to those wearing Congress badges and those presenting invitations. Special electrical features had been prepared. The central court was illuminated by lines of incandescent lamps radiating in all directions from a central support. The space between the building and the Grand Basin was overhung with incandescent lamps of varying colors. Frames of varying designs, thickly studded with incandescent lamps, were placed in the Grand Basin. Music was furnished by several bands located in the court and balconies. The main corridor of the building served as a dancing floor. Lunch was served on the southern balcony facing the cascade. The eastern colonnade and an approach to the lagoon had been roped off, giving free access to the gondolas and launches to all the guests. These latter were tastefully decorated with incandescent bulbs and presented an attractive sight as they moved over the waters. Six floats with colored incandescent Nernst mercury vapor lamps were moored around the shores of the lagoon. Cooper Hewitt tubes were used in the decoration of one of the floats. These were in the shape of the first letters of "Louisiana Purchase Exposition."

On Wednesday evening Mr. Ward Leonard gave a dinner at the German Pavilion to some of the more prominent members of the Congress. On Thursday evening a formal dinner was given by the president and officers of the Congress to the official and society delegates in attendance at the Congress.

Thursday evening Dr. F. A. C. Perrine gave a fascinating lecture on "Long-Distance Transmission," fully illustrated with lantern slides of work on the Pacific Coast and elsewhere. This was in the Westinghouse theatre in Machinery Building where also members of the Congress had an opportunity to witness the series of moving pictures taken in the Westinghouse works by means of the Cooper Hewitt mercury vapor arc lamp. Thursday noon Mr. George Bullock entertained a number of the prominent members of the Congress at a luncheon on the Exposition grounds.

Friday afternoon from 4 to 6 the Commissioner General of Great Britain and Mrs. Watson received the president and members of the Congress at the British National Pavilion.

On Friday evening the St. Louis reception committee gave a banquet at the German National Pavilion at the Exposition grounds, entertaining as guests all the foreign delegates to the Congress, all of the foreign members of the Congress, and all the officers of the Congress, the entire membership being invited to subscribe and attend. About 250 were present and it proved to be one of the successful social events of the week. Mr. R. K. Gray, Dr. Lewald, Prof. Ascoli and Messrs. Hammond, Lieb and Arnold responded to toasts. Director F. W. Lehmann of the Louisiana Purchase Exposition acted as toastmaster.

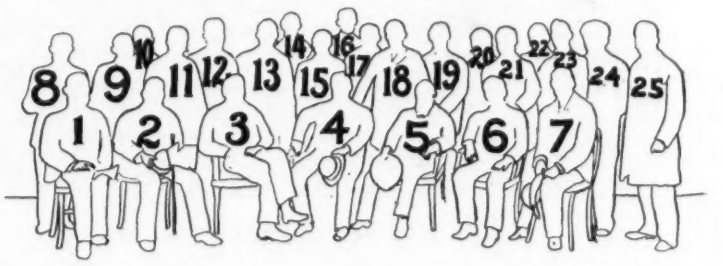
On Saturday President Gray gave a luncheon at the New York State House to the officers and delegates of the Congress.

Chamber of Delegates, International Electrical Congress.

The Chamber of Delegates at the International Electrical Congress included representatives from eleven countries. The Congress was notified of appointments in addition from Austro-Hungary, Mexico and Switzerland, but the representatives from these countries did not appear at St. Louis. Of the five representatives of France, one did not report, and Prof. Henri Poincaré did not arrive until after adjournment of the Chamber.

The group on the opposite page includes all of the delegates present at the sessions of the Chamber except Herr Joseph Vater, of Hungary, whose portrait appeared in our issue of September 10. The accompanying key and following list of names will serve to identify the portraits:

1, Herr W. Litzrodt, Germany; 2, Prof. Dr. S. Arrhenius, Denmark and Sweden; 3, Dr. R. T. Glazebrook, Great Britain; 4, Prof. Elihu Thomson, United States, president; 5, Prof. Moise Ascoli, Italy; 6, M. Zuillebot de Nerville, France; 7, Señor Antonio Gonzales y Echarte, Spain; 8, Prof. Harris J. Ryan, United States; 9, Signor A. Maffezzini, Italy; 10, Dr. F. A. Wolff, Jr., assistant secretary; 11, Herr Bela Gati, Hungary; 12, M. Dennery, France; 13, Ormond Higman, Esq., Canada; 14, Dr. A. E. Kennelly, United States, secretary; 15, Señor Miguel Otamendi, Spain; 16, John Hasketh, Esq., Australia; 17, Capt. Ferrie, France; 18, Col. R. E. B. Crompton, C. B., Great Britain; 19, Prof. Jorge Newbery, Argentine Republic; 20, Prof. L. Lombardi, Italy; 21, Marquis Luigi Solari, Italy; 22, Dr. Samuel W. Stratton, United States; 23, Prof. H. I. Carhast, United States; 24, Prof. John Perry, Great Britain; 25, J. C. Shields, Esq., India.



KEY TO PORTRAITS ON OPPOSITE PAGE.

CHAMBER OF DELEGATES, INTERNATIONAL ELECTRICAL CONGRESS OF ST. LOUIS, 1904.

CURRENT NEWS AND NOTES.

OPPRESSIVE SPEED LAWS.—Automobiles are not the only vehicles subject to oppressive speed laws. Trolley cars are in the same category. A recent instance is furnished by the following dispatch from Lincoln, Neb., of September 15: "Beginning to-day, the maximum speed at which Lincoln Street cars can run is seven miles an hour, and many people prefer to walk. The change is the result of a fight between the city administration and the traction company, because of the abolishment of passes for policemen. The latter resurrected an unrepealed horse ordinance limiting street cars' speed, and demanded its enforcement."

ELECTRIC POWER ON DELAWARE & HUDSON.—It is stated that the Delaware & Hudson Company has practically completed preparations to operate electric trolleys on all its northern divisions, in the endeavor to retain the patronage which has been going lately to the electric roads in its territory. The plan is to operate trolleys over the rails of the steam roads in a way not to interfere with the steam trains. The company, it is said, has decided to employ the side trolley. The first of the Delaware & Hudson lines to be electrically equipped probably will be the line between Albany and Saratoga. The Adirondack Railroad and other branch lines will be similarly equipped. It is the expectation that the new electric lines will be in operation by the early part of next year.

MULTIPLE MOTOR CONTROL.—Mr. W. Baxter, Jr., whose name for many years past has been connected with electric railway and power motor work, has just received a patent for a new system of multiple motor control, intended for railway operation, but applicable to any case involving the operation of a number of motors from a single point by a master switch or controller. There are no fewer than 84 claims. The drawings show series-parallel relation. The first claim runs thus: "In a motor-controlling system, the combination of a master-switch; a controller consisting of electromagnetic switches, independently connected, and arranged to act in succession with progressively increasing energizing-currents; conductors connecting the magnets of the controller in proper relation and terminating in one wire for each direction of rotation of the motors; and conductors connecting the controller-circuit terminals with the master-switch; said master-switch being adapted to connect the terminal wires of the controller-magnet circuit with a source of electric energy and to reduce progressively the resistance in these circuits."

INCANDESCENT LAMP BULB.—Mr. F. M. F. Cazin, of Hoboken, N. J., has received a patent for a double-bulb incandescent lamp. As present practice has it bulb lamps are housed and protected in and by but one glass wall; yet it is a well-established scientific fact that glass passes light with but trifling loss, but resists the passage of heat to a remarkable degree. Consequently a portion of heat is preserved or retained in the lamp-bulb. This heat retained is greater when there are two sheets of glass separating it from the atmosphere. The use of two separate factory-made bulbs increases the glassblower's work and also results in a non-uniform product. Incidentally Mr. Cazin utilized the presence of a double glass wall in housing the luminant for the purpose of differential cooling of a limited minor part of the inner glass wall exclusively exposed directly or indirectly to air circulation, such differential cooling having the new and useful effect of concentrating on the better-cooled minor part of the inner glass any and all condensation of vaporized matter escaping from the luminant under current. In an earlier patent Mr. Cazin embodied his invention of differential cooling by direct exposure to the atmosphere of a limited minor part of the inner glass wall, and by this application he now seeks protection also for the idea of indirect exposure coincidental with limiting and regulating such cooling by means of admitting to and regulating by apertures in the base part of the lamp a limited and regulated quantity of air.

BLOCK SIGNAL SYSTEM.—Mr. F. B. Corey has assigned to the General Electric Company a patent just granted him on a block signal system. It relates to block-signal systems in which alternating current is employed for operating the signals, and the object is to diminish the self-induction of the rail-circuits, so as to render possible the satisfactory operation of such systems over very long blocks. The voltage that can be impressed on a rail-circuit is limited by the insulation of the rails, which is necessarily low, and consequently the length of blocks with which satisfactory operation can be obtained is limited by the impedance of the rail-circuit, since it is important that the source of current be connected to one end of the block and the signal-operating relays at the other end in order that a break in the track may be detected and since with great length of block or high impedance not enough current can be obtained for satisfactory operation of the signals. When direct current is used for the signal-circuit, the impedance of the rail-circuit is simply its ohmic resistance and sufficient current may be obtained with long blocks; but when alternating current is used in addition to the resistance the rails offer a considerable self-induction, owing to their distance apart, and the current for a given length of block is greatly reduced. That means that the permissible length of block is much less with alternating than with direct current. Mr. Corey provides means for diminishing the self-induction of the rail-circuit, and thereby increases the length of blocks permissible with alternating current.

PUSH BUTTON THIRD RAIL.—Mr. Asa F. Batchelder has secured a patent on what appears to be a "straddle" between "push button" contact devices for electric railway operation and regular third-rail methods. An assignment has been made to the General Electric Company. This invention relates to a novel means for supplying current to electrical vehicles; and it consists in providing substantially inclosed boxes or housings which are mounted at intervals along the way parallel to the traction-rails and which contain separate contact devices connected to the mains. Each box is provided with a narrow slot adapted for the passage of a car-collector, which is of suitable construction for entering the slot and engaging the contact within the box, and the car-collector is of suitable length to bridge at least two of the separate contacts mounted within the boxes, so that current will be continuously supplied to the motors on the vehicle. The system is adapted for railway yards or sidings, where comparatively low speeds are attained; but it is contemplated that by suitably mounting the separate contacts and car-collector the system may be utilized on higher-speed railways. Instead of an expensive equipment of electromagnetic switches or third-rail construction cheaply-constructed, separate boxes are provided, which can be mounted a considerable distance apart along the line of way, and a car-collector of little more than the ordinary length can be used, provided it be of sufficient length to bridge at least two successive contacts. The boxes may be constructed entirely of metal, if desired, as they are so small compared to the housing of a third rail that the cost would not be prohibitive.

LETTERS TO THE EDITORS.

"Electrigizing" a Machinery Plant.

To the Editors of Electrical World and Engineer:

SIRS:—Why do not writers and publishers use the right and concise word when speaking of installing, working, operating or energizing machinery or power plants with electricity? I notice some of our foremost periodicals use "electrify" and its derivations. Now, the common meaning of electrify is "to thrill"; technical meaning, "to charge with electricity." What is wanted is a word bearing out the meaning of "work, operate, energize," and since electro is Greek the verbal ending should also be Greek and that Greek verb is "ergo," well Anglicized in the words "en-ergy, en-ergized," etc. I leave it to the electrical literati whether a machine or power plant would not run longer and steadier *electrigized* than it would if only *electrified.*

NEW YORK CITY. ROBERT W. MASON.

The Regulation of Wiring.

To the Editors of Electrical World and Engineer:

SIRS:—I note in your issue of September 10 an article by Capt. William Brophy, on Municipal Electricians, etc., and I would state for the information of Mr. Brophy that his ideal of a combination has been tried and found wanting. Human nature interfered with its success. Some four years ago such an agreement was entered into between the electrical contractors, the several lighting companies and the underwriters. Their signatures had hardly become

dry when all concerned made a greedy rush for what was in it, making an effort to squeeze out every electrical worker not a member of the Contractors' Association. They presumed that, having the underwriters with them, they could crush out all competition. It is just such unjust combines as Mr. Brophy proposes that to-day are undermining our republic, and unless a stop is put to such special legislation as has been granted in many lines of industry to benefit different organizations, we will find ourselves face to face with a revolution. Every year I notify my legislator at Albany to be on the lookout for just such propositions as the Brophy one. Special legislation in the interests of powerful organizations is fast degenerating our young men who are poor in finances. These organizations shut the door of hope against young men. To be a great and grand nation, all must have an equal chance; the young men must have a fair show. For oneself to prosper to any great extent, the young men of the country must prosper also, and if they do not you can prosper only temporarily.

LITTLE FALLS, N. Y. ALFRED PEKINGSTON.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Energy Losses in Magnetizing Iron.—MORLEY AND HANSARD.—An abstract of a British Association paper in which they drew attention to the fact that many engineers are content to measure the hysteresis loss by Ewing's tester and to neglect the losses due to eddy currents. The authors recommend the wattmeter method which gives the total loss, and they record the results of their experiments on sheets of 14 mils, 19 mils and 25 mils thick at inductions of 2,500 to 10,000 and frequencies of 50 and 100. Their figures show the eddy current loss to be from 36 to 64 per cent. of the total, while it increases rather less quickly than the square of thickness and the square of frequency. They also found that rise of temperature diminishes the eddy current loss by 27 per cent. between 40° and 167° F. They conclude that until some good magnetic material of high specific resistance is introduced, the only way to reduce eddy current losses is to use as thin iron as possible. In the discussion Hadfield suggested that temperature changes might account for some anomalies in the results, and stated that he had been experimenting with an aluminum-iron alloy of low hysteresis and a resistance three or four times that of pure iron; at present the difficulties of rolling it prevent its use. Stoney suggested that the shape of the alternating wave might affect the results, a number of tests on large alternators having shown the eddy current loss to be 90 per cent. of the total.—London *Elec.*, Aug. 26.

POWER.

Electric Equipment of a Scotch Colliery.—SMITH.—A description of the power equipment at Houldsworth colliery, which includes a Parsons steam turbine, the first erected for colliery use in Scotland. This turbine, of the latest parallel compound type, adapted for the full range of expansion, from the initial pressure of 100 lbs. to the condenser pressure, is coupled direct to a continuous-current dynamo giving an output of 200 kw at 500 volts and 3,500 revolutions. The electric current is conveyed to the shaft bottom by vulcanized cables armored with two layers of galvanized wire. They are supported in the shaft by pitch-pine cleats, 6 ft. long by 12 in. wide, having a groove narrow enough to grip the cable firmly, fixed to the buntons at intervals of 120 ft. At present the current from the turbine is taken to a Riedler pump at the shaft bottom, and to a small three-throw pump. This takes up less than half the power available, and that in reserve will be used to duplicate the shaft pump or for haulage purposes.—*Eng. and Min. Jour.*, Sept. 1.

Electric Power in Factories.—A note on some points in the annual report of Ram, the electrical inspector of factories in England. He calls attention to the common practice of cleaning and carrying out repairs on switchboards and apparatus which are supposed to be dead, but are in reality very much alive. He suggests that substation bus bars should always be definitely connected to earth before work is commenced on them. He is also strongly in favor of "remote control" switchboards. With regard to overhead electric cranes he advocates earthing the entire frame work. The door of the cage should operate the motor switch.—Lond. *Elec.*, Aug. 26.

REFERENCES.

Pumps.—BAUM.—The first part of a well-illustrated description of some recent pump installations in German mines. The present installment does not refer to electric pumps.—*Glueckauf*, Aug. 20.

Planer.—An illustrated description of an electrically driven planer with speed-changing countershaft.—*Amer. Mach.*, Aug. 25.

Electric Cranes.—GUARINI.—An illustrated description of electrically driven jib cranes erected on the Admiralty Pier at Dover.—*Scient. Am. Sup.*, Sept. 3.

TRACTION.

Canal Traction.—DAVIES.—An illustrated review of the present state of mechanical canal traction. He describes the Bovet chain hauling system which appears to have met with a certain measure of success on the Seine between Paris and Rouen. A chain is laid in the bed of the canal, and the tug barge, fitted with a motor-driven drum round which the chain make a three-quarter turn, hauls itself along in this manner. Current is taken from an overhead line by means of a trolley, and returns through the chain to earth. Formerly ordinary methods of chain haulage had necessitated the taking aboard of large lengths of cable, in order to obtain the necessary amount of adhesion to the driving drum. This was found to be not altogether desirable, and as a consequence the magnetic pulley illustrated in Fig. 1 was introduced by Bovet, which has the

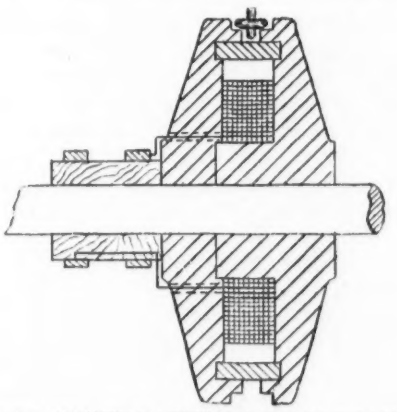


FIG. 1.—MAGNETIC ADHESION CHAIN PULLEY.

effect of greatly increasing the adhesion of the chain, although only a small length is taken on board. The pulley is of mild steel, 4 ft. in diameter, and is wound internally with a powerful magnetizing coil after the style of the Mordey alternator. The periphery is split in a manner suitable to the form of the chain, which, in passing over, completes the magnetic circuit and therefore adheres very strongly to the pulley face. The ends of the coil are taken to two slip-rings mounted on an insulating bush on the shaft. An advantage of this arrangement is that, although increased adhesion is obtained, slip is still possible in cases of emergency, such as the chain fouling. Perfect adhesion could, of course, be ensured by the use of a pulley cut to fit the chain, but this would be at the expense of risk should anything go wrong with the towing arrangements, as is always possible with this system. From experimental trials of the Bovet system, it was found that the hourly current consumption of a 200-ton barge was 3.2 units when moving at the rate of approximately two miles per hour, which result is about equal to screw propulsion, and a large saving over horses. This system is very suitable for tunnels, has the advantage of leaving the towpath free, does not deteriorate the banks, and requires but little alteration to the barges. Its disadvantages are chiefly the difficulties met with at bends, and the delay that would be caused by a breakage of the chain. Another system described is the tractor system of Thwaite. The details of this arrangement are shown in Fig. 2. Each tractor

is simply a motor mounted on four wheels, two running on top and two underneath the rail, all four wheels being driven by the motor through worm gearing running in an oil-bath. Lateral movement of the motor is provided for by spring-controlled horizontal rollers pressing against the side of the rail. Mechanically, this arrangement is rigid and very suitable to take up the side pull of the tow-rope, and its adhesion to the rail must be very high. A bare conductor consisting of angle iron or copper strip is carried on insulators fixed to a wooden batten, which in turn is attached to the underneath side of the rail as shown. A collecting brush rubs against this, and the

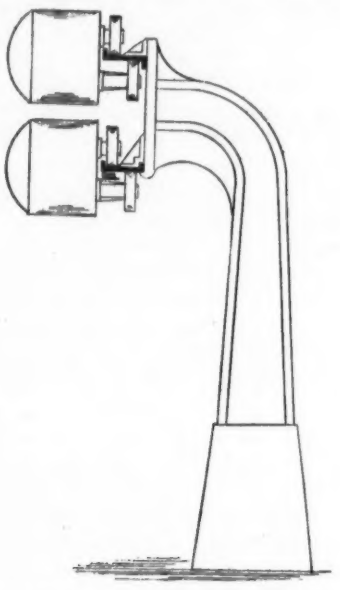


FIG. 2.—CANAL HAULAGE SYSTEM.

current returns through the wheels to the track in the usual manner. The control of the tractor may be effected in various ways, according to whether the starting switch is fixed to it or placed on the barge. In the latter case a twin cable running along the tow-rope is all that is necessary, and in the former the control may easily be effected by the aid of cords attached to the switch handle. The running cost of this system is given by Allen as 0.064 cent per ton-mile at a speed of 2½ miles per hour and 0.082 cent at 4 miles per hour, which figures are inclusive of depreciation, interest and all revenue charges. The capital cost of the aerial railway is estimated at $9,000 per mile, and the total expenditure for a 30-mile canal, including all generating plant, is given as $387,500 for a low speed of propulsion, while at 4 miles per hour the above figures are increased to $12,000 and $498,000 respectively. The Thwaite system of haulage does not call for any alteration to the existing floating stock. Some brief notes are given on those methods in which an electric locomotive runs on the tow-path.—Lond. *Elec. Eng.*, Aug. 19.

Electric Railway Test Commission.—MARSHALL.—An account of the progress of the work of the Electric Railway Test Commission. An investigation has been completed of the storage air compressing plants used by the St. Louis Transit Company. Measurements were made to determine the energy consumption in compressing a given amount of air, the efficiency of the cooling system, the thermodynamic losses, the amount of air consumed by each car on the line per stop, and the various losses throughout the system from the electric motor to the air-brake cylinders. Another series of experiments involves measurements of the voltage drop and power loss on steel rails carrying alternating current. And a test of the drawbar pull of a storage battery electric locomotive. Braking tests are also in progress on the experimental track in the Fair grounds, and later on train resistance tests will be held on an interurban line in Indiana.—*St. R'y Jour.*, Aug. 20.

REFERENCES.

North London.—The continuation of an illustrated article on power supply of tramways in North London. This installment deals with the construction of the switchboard in the Brimsdown Station.—Lond. *Elec.*, Aug. 26.

Mont Blanc Railway.—A note stating that the project for an electric mountain railway up Mont Blanc, which has been submitted to the French authorities by a financial syndicate, has received the committee's official sanction. Metre gauge has been selected. The trains will be composed of two cars and the maximum speed is to be 8 km per hour.—Lond. *Elec.*, Aug. 26.

Rails and Rail Joints.—COLE.—A description of a series of tests conducted in Europe with joints laid on rails 165 mm high and weighing 48 kg per meter. There were fifteen rails in all, laid with five different kinds of joints. Particulars of the tests are given. The electric efficiency at the end of the first year was very largely in favor of the thermit joint. Statistics are also given of the wear of the rails.—*St. R'y Jour.*, Sept. 3.

Maintenance of Trolley Systems.—HECKER.—A statistical article on the cost of maintenance of the electric equipment of trolley lines.—*Elek. Zeit.*, July 28.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Regulations.—A reprint of the revised (British) Board of Trade Regulations under the Electric Lighting Act, with an editorial pointing out the principal changes. In the rules as to earthing the middle wire of a three-wire system it is made clear that this is to be done at one point only and that the current flowing from the middle wire to earth at this point is not to exceed one-thousandth part of the maximum supply current. On such systems it is laid down that if the districts of the network are interconnected, this is to be done only through fuses or circuit-breakers. No fuse is to be allowed on the middle wire in the surface boxes.—Lond. *Elec.*, Aug. 26.

Harcourt Pentane Lamp.—C. C. PATERSON.—A British Association paper giving the results of an investigation carried out at the British National Physical Laboratory in order to determine the change of the candle-power of the 10-cp Harcourt pentane lamp, due to variation, first in barometric pressure, second in the quantity of water vapor present in the air. He states humidity volumetrically as the number of liters of water vapor to a cubic meter of pure, dry air at the barometric pressure existing at the time. The author gives the following formula for correcting the candle-power of the lamp to the standard atmospheric conditions of 760 mm. of mercury and 10 liters of water vapor per cubic meter of pure, dry air: Candle-power $= 10 + 0.066\ (10 - h) - 0.008\ (760 - b)$, where h is the humidity as defined above, and b the height of the barometer in millimeters. From this it will be seen that a variation of 1 liter per cubic meter in the moisture causes a variation in candle-power of about 0.7 per cent., and that 10 mm. change in barometric pressure brings about an alteration of 0.8 per cent. in the illuminating power of the lamp.—Lond. *Elec.*, August 26.

REFERENCE.

Circuit-Breakers.—W. M. SCOTT.—A fully illustrated paper on the construction and uses of "reverse-current" circuit-breakers or discriminating cut-outs which automatically sever the circuit in the event of the flow of current being abnormal in direction and which, unless interrupted, would result in misapplication of energy. After some general remarks on circuit-breakers of this type, the author discusses in detail their application to the protection of generators; rotary converters; transmission lines in multiple; storage batteries and systems of which storage batteries form a part; storage battery boosters, and finally, boosters supplying feeders.—*Jour. Franklin Inst.*, Sept.

ELECTRO-PHYSICS AND MAGNETISM.

N-Rays.—A brief account of a discussion before the recent Brit. Ass'n meeting. It was opened by Lummer, Becquerel having left the room before: "Lummer started with the very candid statement that the subject would not have been worth notice but that the French Academy had recently awarded a prize to Blondlot for his work on N-rays. He was aware, of course, of the photographic evidence which had been produced for the existence of N-rays, but thought the exact procedure in these experiments had yet to be carefully scrutinized. He quoted Becquerel's opinion that N-rays have their effect by being reflected into the eye and augmenting the sensitiveness of the retina. As for himself, he was inclined to the opinion that the result was largely physiological, perhaps even in some degree psychological. He described, to ilustrate his physiological possibility, an experiment which can be performed with a candle in one's bedroom—though, as he said, the observer's time would be much better occupied in sleep. The experiment consists in approaching a candle toward the eye in a line parallel to and to one side of the visual axis. At a certain distance, the pupil be-

gins to undergo contractions, giving the impression of variable luminosity." Of the members present 15 had made experiments to detect N-rays, but only one claimed to have succeeded. The latter described cases in which an observer watching a phosphorescing screen had detected the approach to the back of the screen of pieces of various substances. Rubens remarked that he had once persuaded himself he could trace dimly the motion of his hand behind such a screen, but had found he could not do likewise with other people's hands. He thought that "suggestion" had a great deal to do with the alleged phenomena. Butler gave evidence of the effects of "suggestion" and pointed out in this connection that since Blondlot's measurement of the velocity of Roentgen rays is interlinked to some extent with his N-ray researches, that measurement ought to be carefully repeated. "Thus, it will be seen, the feeling of the meeting was one of cautious, not to say uncharitable, scepticism."—Lond. *Elec.*, Aug. 26.

REFERENCES.

Alternating Current Theory.—IDANOFF.—A mathematical article in which the author writes some fundamental formulas of alternating current in a certain way, based on considerations concerning the phase difference. He prefers the term "tension factor" to "power factor" and thinks it is possible to avoid such "artificial conceptions as apparent resistance, apparent conductance, energy current, wattless current, etc."—*L'Industrie Elec.*, Aug. 10.

Electrification and N-rays.—BICHAT.—A description of some observations which go to prove that electrification has a notable effect in the observation of N-ray phenomena and may often act as a disturbing element. The electrification may affect the screen, the source of N-rays, or the observer, and should therefore be carefully taken into account.—*Comptes Rendus,* July 25; abstracted in Lond. *Elec.*, Aug. 19.

ELECTRO-CHEMISTRY AND BATTERIES.

Ozonisers.—KERSHAW.—An illustrated article on the production and utilization of ozone. The author describes the ozonisers of Marmier and Abraham, Otto, Siemens and Halske, Vosmaer and Lebret. The endeavor of the experimenters in this line has been mainly the design of apparatus producing silent electric discharge when large volumes of gas are dealt with. The problem is to reduce the losses arising from spark formation and from the decompotion of the ozone already formed. In nearly all ozonisers, glass is used as dielectric between the electrodes. In some, a spark gap is provided in the external circuit, and if the conditions in the ozoniser proper should at times lead to sparking, the main discharge occurs in the external spark gap. Other inventors make use of rotating electrodes, which vary in distance, or in which segmental openings have been made. Should sparking occur with these electrodes, the arc is speedily broken by the increasing distance or by the gaps produced by the rotation of the electrode or electrodes. A third group of inventors use air currents sufficiently rapid to blow out any sparks that may form between the two electrodes, while yet another plan is to use a choking coil in the external circuit, which will not permit the current necessary to maintain an arc to pass into the ozoniser.—Lond. *Elec. Review,* Aug. 19.

Electrometallurgy of Iron.—NEUMANN.—The conclusion of his long serial on the use of electric furnace methods in the iron and steel industry. After giving the cost of various processes, he sums up his conclusions. He believes that in the principal iron industry countries (United States, Germany and England) which have an abundance of fuel and where impure iron ores only are available, the electric furnace cannot be expected ever to become a serious competitor to the blast furnace for the production of pig iron. The conditions are different in countries in which fuel is scarce and where pure iron ores and sufficient water power are available (South America and New Zealand); in such countries the production of pig iron in electric furnaces may be an economical success. But even in countries like the United States and Germany the electric furnace may be used advantageously for making high-grade ferro-alloys. He also believes that the electric furnace is capable of replacing the present expensive methods for making crucible steels.—*Stahl und Eisen,* Aug. 15.

Numerical Value of R.—BERTHELOT.—The well known relation which exists between the pressure p, the specific volume v (i. e., the volume of one gram molecule of the gas) and the absolute temperature T at sea level at a geographical latitude of 45°, is $p\,v = R\,T$. The author reaches the conclusion that $R = 0.08207$ with an error not exceeding 1-8000.—*Zeit. f. Elektrochemie,* Aug. 19.

REFERENCES.

Bunsen Society.—DANNEEL.—The conclusion of his rather full report of papers presented at the last general meeting of the Bunsen Society. Among the papers abstracted are those on hylotropy by Ostwaid; on stereochemical obstructions of electrochemical reductions by Elbs; on the catalytic action of cyanogen iron by Bredig; on the chemistry of cathode rays by Bose, and various papers on the application of the principles of physical chemistry to medicine and biology.—*Electrochem. Industry,* September.

Aluminum Anode.—MOTT.—An account of an experimental investigation of the electrical properties of the films which form on an aluminum anode. He considers especially the specific resistance, insulating strength and specific induction capacity of the film.—*Electrochem. Ind.,* September.

Electrometallurgy.—IZART.—In a continuation of his serial on the present condition of electrometallurgical industries he deals with electrolysis of aqueous solutions. He speaks of the production of copper from ores and of electrolytic copper refining.—*L'Ind. Elec.*, August 10.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Prepayment Meter.—An illustrated description of the Hookham prepayment meter, Fig. 3, shows all the main features of this prepayment meter as arranged for continuous current. *A* is the check reservoir, drawn with part of the exterior removed so as to exhibit the checks, which consist of a number of small steel spheres contained in a spiral groove. The checks are put into this groove from the top and escape one at a time at the bottom. *B* is the slot into

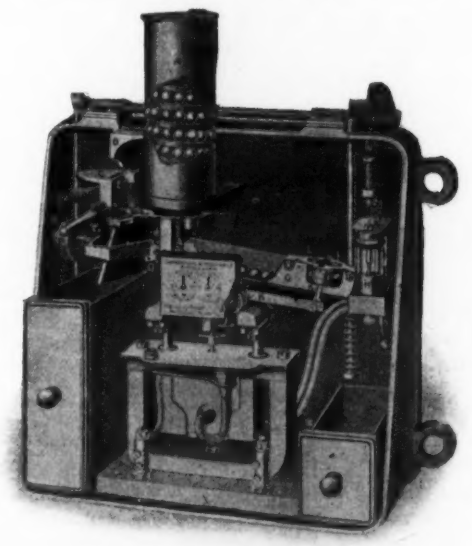


FIG. 3.—PREPAYMENT METER.

which coins are inserted so as to fall into the receptacle *C*. *D* is a lever projecting through the front of the case. After a coin has been inserted and has fallen into *C*, the lever *D* is moved to the left; the coin standing edgewise in *C* first encounters and lifts the catch *E*, thus allowing *D* to be moved still farther; it then falls over the edge of an inclined plane *F*, which prevents the possibility of *D* returning until the coin has been discharged into the coin drawer on the left. The forward movement of *D* works a small pusher under the check reservoir, which carries out a check and drops it into a pivoted beam *G*. One check is sufficient to depress the beam, thus causing contact to be made by means of the mercury cups *H* and permitting a supply of current to pass to the lamps. Any number up to eight checks may, however, remain in the beam, allowing the customer to put in a maximum of eight coins at a time. Each check as it falls into the beam passes over and tilts a small weighted lever at *I*, which is so arranged that, if the beam becomes full of checks, more cannot issue from the reservoir. This in turn prevents any more coins being inserted until, under the action of the meter, a check has passed from the beam. The release of the checks from the beam is effected through the medium of the counting train of the meter. One of the wheels carries the crank-pin *J*, which, in rotating, rocks the connecting rod and lever *K*, backward and forward. To the lever *K* is attached a

horizontal bar carrying two small vertical screws, *L, L;* the whole arrangement forms a kind of escapement, the slow to and fro movement of which releases the checks one at a time. The speed of the meter and the wheel train of the counter are so adjusted that the desired value in electric current releases one check from the beam. After escaping from the beam, each check falls into the check drawer on the right-hand side of the meter. When the meter has been in use for some time the coins are collected and all the checks in the drawer returned to the reservoir. The coin and check drawers are secured by vertical spring bolts at the back of the meter, which are depressed by the movement of a horizontal bar along the top of the case. The movement of this bar also secures the cover for the check reservoir, and it carries a lid which seals a small hole in the case. The hole is provided so that a screwdriver can be inserted for the purpose of raising the screw *N*, which, when down, presses the end of the beam firmly down upon the mercury cups, effectually sealing them up and preventing a loss of mercury, or oil with which it is covered, in transit. Different counting trains are provided, according to the price per unit which is to be charged, and they are stamped accordingly. The wheel on the worm spindle may be varied according to the voltage of the supply and the constant of the meter. A dial shows the consumer how many coins are still left unused in the beam, while two dials below indicate to the collector the number of coins he ought to find in the drawer.—Lond. *Elec.*, Aug. 26.

TELEGRAPHY, TELEPHONY AND SIGNALS.

REFERENCES.

Automatic Block Signals.—SCOTT.—An illustrated article, the first of a series, on automatic block signals. For some unknown reason the attention of electrical engineers has rarely been openly directed to the important field occupied by the automatic railroad signal, which is as much a field for electrical engineers as the storage battery or synchronous motor. The article treats of signals from a purely electrical standpoint and is well illustrated. In the present article the signal semaphore arrangement and signal circuits are taken up.—*Amer. Elec.*, August.

Telephony.—GRADENWITZ.—An illustrated description of the Janus telephone system, designed to meet the conditions in Germany, where the main telephone lines are owned by the State. It enables each telephone of a private network to be used simultaneously with those belonging to the main telephone system; it is designed to warrant an efficient supervision on the part of the State, eliminates the risk of unlawful connections and makes the private lines the last continuation and ramification of the State telephone system.—*Sc. Am. Sup.*, Aug. 27.

Italy and Wireless Telegraphy.—A note taken from *Elettricita* and stating that the Board of Audit has rejected the convention stipulated between the Italian Government and Marconi. It is also stated that the convention is illegal, and that the newly-inaugurated wireless telegraph route between Bari and Antivari (Montenegro) must be taken over by the Government, which alone has the right of distance communication by telegraph, and, finally, that Marconi should not be allowed to go on with the Coltano (Pisa) plant at his expense, such being against the fundamental law regulating communication.—Lond. *Elec.*, August 19.

MISCELLANEOUS.

Electricity and Plant Growth.—PLOWMAN.—An account of experiments made to explain the behavior of roots growing in the presence of an electric current. His results show that negative electrons are in no case harmful to plant protoplasm; and in several instances a marked acceleration in growth may reasonably be attributed to their influence. However, in the present state of knowledge it would be imprudent to assert without qualification that negative electrons stimulate vegetable protoplasm. For the present the point of principal interest lies in the fact that the phenomenon termed "galvanotropism" by Elfving has its ultimate cause in the effects of the electrons, or electricity per se, and apart from any streaming of ions or any ordinary chemical reaction. The author, therefore, believes the term "electrotropism" to be more appropriate. The results of his studies seem to indicate that whatever advantages may be derived from the use of electricity in practical horticulture are to be attributed rather to secondary chemical and thermal effects than to electric energy as such, except, perhaps, in cases where plants are negatively charged.—*Amer. Jour. of Science*, September.

New Auto Telegraph Car.

The new auto-telegraph car of the United States Signal Corps is interesting not only as the first demonstration, in so far as the American army is concerned, of the practicability of motor cars for utilization in warfare, but also as the pioneer of a class of "flying" telegraph and telephone stations which bid fair to prove of the greatest value in military field work, particularly where a force of soldiery is moving rapidly in its campaigning. The new car, which

AUTO TELEGRAPH CAR OF U. S. SIGNAL CORPS.

is the only one of the kind in the world, is now stationed at the Signal Corps Post at Fort Myer, Va., where government experiments in military communicative work are carried on.

The introduction of guns of increased range and the adoption of new military tactics whereby troops in the field are scattered over a wider territory than was formerly the custom has made it necessary to transmit orders with the utmost speed and accuracy, and has resulted in the virtual discarding of many of the older methods of signaling and the placing of almost sole reliance upon the telephone and telegraph. Indeed, one-third of the entire personnel of the Signal Corps is now made up of skilled electricians—linemen and operators.

With all their speed and skill in erecting military telegraph and telephone lines, the Signal Corps have frequently found themselves seriously handicapped in attempting to keep pace in line construction with the advance of a rapidly moving military force, as for instance a cavalry detachment. Now the slow-moving wagons on which reliance had previously been placed to transport the wire and instruments are to be replaced by high-power and speedy auto cars of the type of the initial machine just provided, and it is believed all the old difficulties will be obviated.

The new auto telegraph car is very similar in design to a touring car of the Winton type, with the exception that the regulation tonneau has been replaced by one of larger size with seats along the side and an operator's table for the instruments directly beneath the forward seats. Under the seats is ample storage space for many reels of the light-wire used by the Signal Corps and for an ample equipment of instruments, including the latest improved "sounders" especially adapted for work under war conditions. At the sides of the car are racks on which are carried lances or poles for use in stringing a temporary overhead telephone or telegraph line when other supports are not available.

Joint for Stranded Wires.

A device for coupling stranded wires has just been placed upon the market by Dossert & Co., 114 Liberty Street, New York. The joint is made of seven parts, six of which are in pairs. They consist of an inside ring. an outside ring, and a compression nut. The

FIG. 1.—JOINT AND PARTS.

remaining part carries nipples on which are screwed the compression nuts carrying the wire properly prepared. These nipples may be in the form of crosses or tees or may be cast on to bus bars of fittings of any kind, thus enabling the cable to be fastened securely thereto.

Fig. 1 illustrates a type of the joint and shows its construction to good advantage, the strands being cut away so as to show the inside compression ring.

On millivoltmeter test by the makers the joint showed a conductivity greater than that of an equal length of wire. The joint was also subjected to a test in a welding transformer, and it was found that as the current was gradually increased, the wire melted before

FIG. 2.—MECHANICAL TEST ON JOINT.

the joint broke circuit, thereby conclusively proving its continuity. It is claimed by the makers that no soldered joint could possibly stand this temperature, as the melting point of solder is much below that of copper.

For the purpose of determining the mechanical strength of the

FIG. 3.—MELT DOWN TEST ON JOINT.

joint it was subjected to test in a tension machine, where it developed more than two-thirds of the strength of the cable it united. The firm guarantees the joint to stand 50 per cent. of the strength of the cable. Another advantage possessed by the Dossert joint, it is pointed out, is the facility with which it can be made, and there is no waste of cable in the operation.

Dossert & Co. propose to utilize these joints in overhead construction, in manholes and conduit work where it is dangerous to take a torch; in switchboard construction, dynamo trimmings, for electric meters, railway motors and car equipments, and in fact for all places where heavy wire has to be connected to devices of any character.

An Aluminum Exhibit at St. Louis.

One of the most prominent exhibits in the Metal Pavilion at the World's Fair is that of the Pittsburg Reduction Company. This exhibit covers a space 48 by 24 feet in the northern corner of the building. It consists of various aluminum articles made either by the Pittsburg Reduction Company or from aluminum of its production. The great variety of articles on view show what an important place aluminum has gained in the manufacturing world in a comparatively short time.

Its extended use in the electrical industry is well shown in the exhibit. Bus bars, cables, cable connectors of aluminum are exhibited. Frames, covers and discs of integrating wattmeters, the needles and covers of ammeters and voltmeters, the reflectors of arc head-

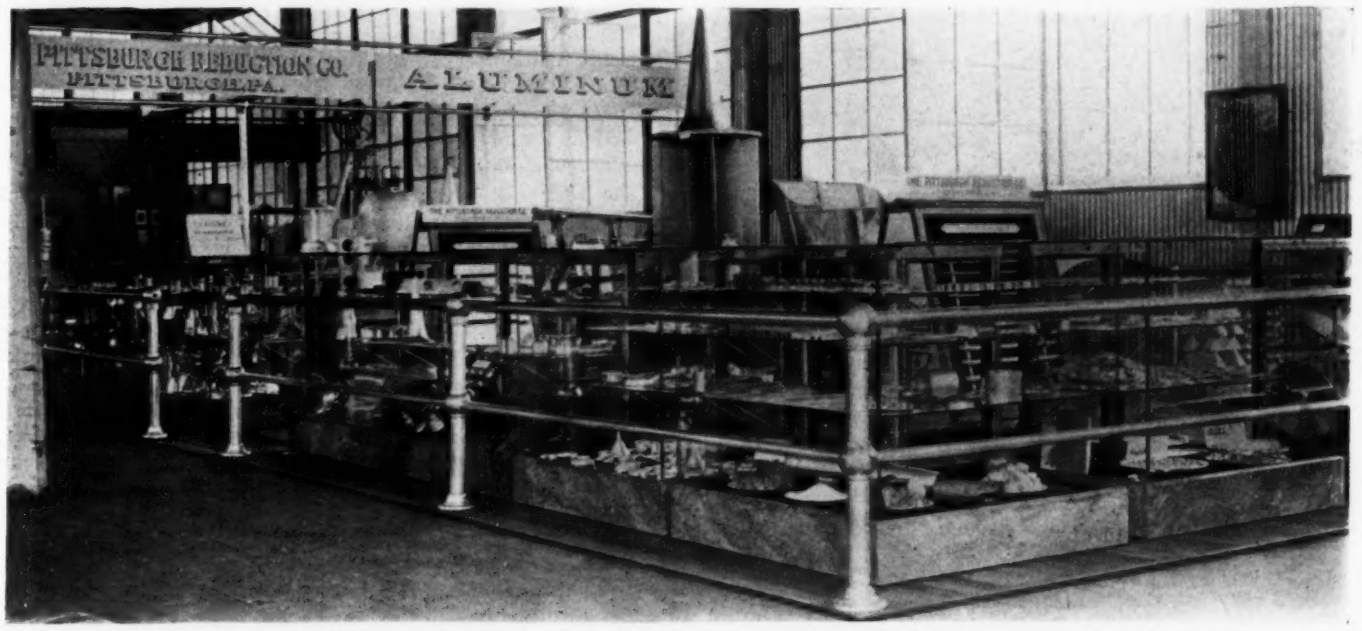


EXHIBIT OF PITTSBURG REDUCTION COMPANY.

lights, are also shown made of the metal. Quite a variety of feeder wires for electric railway transmission are exhibited, the largest being 2,000,000 circular-mils copper equivalent. Automobile parts are made and are in evidence in great varieties. One of the larger features of the exhibits consists of an automobile bed made of aluminum. Cooking utensils, table ware, match boxes, typewriter parts of aluminum are also shown.

A working exhibit occupies the southern portion of the space. This consists of a wire-drawing and a wire-braiding machine. The wire-drawing machine is supplied with No. 4 aluminum wire. This after passing through six sets of dies is reduced to No. 14 wire. The braiding machine is shown covering aluminum wire with three layers of braid. This is the first step in covering the wire with insulation. The whole exhibit is surrounded by an aluminum railing which shows an additional and artistic use of the metal.

The Chicago Fuse-Wire and Mfg. Co's Exhibit.

One of the exhibits located in the colonnade of the court of the Palace of Electricity is that of the Chicago Fuse-Wire & Manufacturing Company. The exhibit occupies floor and wall space near the southwest corner of the court. Here are shown the several fuses and parts manufactured by the company. Spools of tested fuse wire varying in capacity from 1 to 50 amperes are enclosed in the case on the rear wall.

Quite a display is made of the "Union" enclosed fuses. These are shown in varying lengths and sizes adapted to be used with screw or clip connections. Open fuse links of the style so frequently seen in electric railway car fuse boxes, and larger sizes for special service. are shown in sizes from 1 to 3,000 amp. Street metal

fuses is another variety exhibited. The largest of these is of 300 amp. capacity. Among other styles shown are telephone and telegraph fuses and blocks and tubular line fuses.

Other features of the exhibit are the improved wire joints, test connectors, cable hangers, fuse repair kits and Union switch outlet

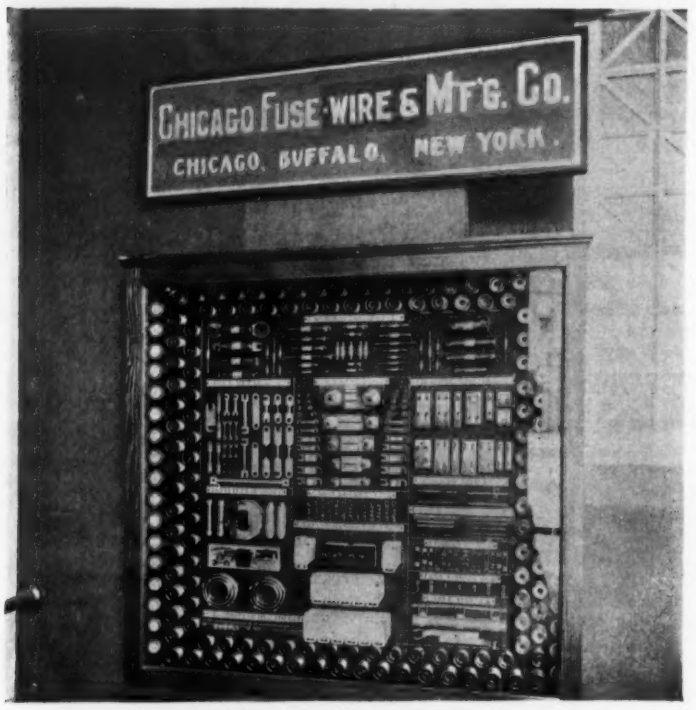


EXHIBIT OF CHICAGO FUSE-WIRE & MFG. CO.

boxes. These latter are used in connection with flush wall switches and are shown in sizes to accommodate from one to six switches. The exhibit is an interesting proof of the wide range attained in this one branch of electrical industry.

Heater for Small Quantities of Liquid.

That a little boiling water is often wanted every day and almost everywhere, yet not readily obtainable, has been appreciated by the Simplex Electric Heating Company, which has placed on the market a very convenient article that seems to meet the demand in the nursery, the sick room, the office, the hotel, on board ship or wherever a lighting circuit is available. As shown in the illustration it is in the form of a cup with a plug and cord. A special feature is that it is so quick to boil that many a cup of tea or coffee will find its way to the busy office man who could not spare

ELECTRIC LIQUID HEATER

the time for it if compelled to bother with sooty gas and slower methods.

It will boil a cup of water in three minutes or a full pint in six from the time of turning on the current, and will warm a cup of milk for the baby is less than two. For shaving, for some warm water to wash one's hands, or for any sudden demand it is just what is required. Being bright, clean and thoroughly sanitary, it can be used directly in a sick-room. It is ideal, for with all the above advantages its high efficiency makes the cost of operating slight because with current at 1 cent per lamp hour a pint of water can be boiled for less than one-third of a cent.

Features of the Contractors' Convention at St. Louis.

A report appears elsewhere in this issue of the business features of the convention in St. Louis, of the National Electrical Contractors' Association. A few "trade notes" and "asides" are also in order.

At the convention were to be seen Manager of Sales Scribner, representing the Western Electric Company.

John A. Roebling's Sons Co. sent two able delegates in Frank W. Harrington and G. W. Swan, and while Mr. H. L. Shippy could not be there, he sent a neat little characteristic souvenir in the shape of a corkscrew made of Roebling wire.

Pass & Seymour were represented by Messrs. Salsbury and Brooks, of the Syracuse office.

Mr. W. S. Sissons, of Providence, was there to talk the merits of D. & W. fuses.

V. C. Gilpin was on hand to discuss Deveau telephones.

The Sprague Electric Company had the Greenfield conduit well spoken for by Mr. Alex. Henderson.

Mr. E. G. Bernard looked after the interests of the E. G. Bernard Co., of Troy.

Mr. Hugo Reisinger, in addition to his duties as World's Fair Commissioner and Juror, had time to make known the merits of "Electra" carbons.

Fred Pearce, of New York, was on hand.

The Crocker-Wheeler Co. sent an able representative in Mr. Gilder, of the home office; and although this was his first convention he made a host of friends.

The Dale Co., New York, were ever on the scene. President John H. Dale and O. J. Bryan came on from New York and distributed a handsome souvenir of their new wireless cluster that has met with such marked success. The increasing call for Dale specialties has caused the company to expand its extensive factory.

Manhattan Electrical Supply Company had two sturdy representatives in Messrs. McDowell and Pierce, from the New York and Chicago offices respectively.

"Flexduct" could not be forgotten, for if it was not whispered in your ear by C. E. Corrigan, it was by Harry Osburn or C. B. Roulet. Mr. Bennet, Chicago representative, was also in attendance as an understudy.

Habirshaw wires had as sponsor Manager J. B. Olson, of the New York office.

W. R. Ostrander & Co. sent Messrs. Vaughn and Monk to look after their interests.

The Electric Appliance Company, of Chicago, sent its very best—William Lowe.

M. B. Austin represented the M. B. Austin Co., Chicago.

"Diamond H" switches were spoken for by W. P. Crockett, Chicago.

Bossert Electric Construction Company, Utica, N. Y., had President Bossert himself as representative.

Charles E. Lee came on from Boston to represent the Electric Gas Lighting Company.

The American Circular Loom Company could not be lost sight of, nor be out of hearing, through the strenuous efforts of H. B. Kirkland, T. H. Bibber and Thomas G. Grier. This was Mr. Kirkland's first convention since his serious illness of last spring, and he was congratulated on all sides on regaining his "old form."

Condit Electrical Manufacturing Company, Boston, was represented by Fred W. Nason, who advocated the merits of Elden circuit-breakers.

Sawyer-Man Electric Company had Representative Jennings, of New York, in attendance.

Alex. Henderson, Master of Transportation, acquitted himself of most arduous duties in a way that gave satisfaction to all. The trip from end to end showed his thoughtfulness for the comfort of the delegates, and much favorable comment was expressed.

The Seidler-Miner Co., of Detroit, had Frank J. Miner in attendance. Mr. Miner has just decovered from a very serious illness.

George Searing was on hand to look after his various lines of apparatus.

Benjamin Electric Company, Chicago, was represented by R. B. Benjamin, manager.

The Schaeffer & Budenberg Manufacturing Company had Mr. A. L. Portong in attendance, and its exhibit of steam specialties at the Fair excited much interest among the delegates.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The transactions on the stock market were on a large scale, averaging upward of 1,000,000 shares per day. It is thought, however, that this was largely due to manipulation, the public participation not being very large. Prices were upheld despite unsatisfactory crop news. The principal feature of the market was the continued advance of the United States Steel stocks, both the preferred and common rising to higher figures than they have touched for a long time. More or less attention was paid to the traction group, and a decline in Metropolitan Securities, accompanied by a report that another call of 50 per cent. may be made upon the holders of the stock, was one of the incidents. Official denials, have, however, been given to the rumors that a sale of the controlling interest in the company to the subway party has been negotiated. There were advances in several of the prominent industrials, General Electric being more or less prominent. This stock reached 175 at one time but receded and closed at 171 ex-div., this being a net loss of 1½ points. Westinghouse common advanced from 162 and closed at 163, one point lower than last week's close. Allis-Chalmers was steady at 50. American Telephone & Telegraph was extremely quiet, 100 shares being sold at 140. Western Union advanced from 91 to 92¼, and closed at 91⅞. Commercial Cable made a jump of 20 points, closing at 210. In the traction list Brooklyn Rapid Transit closed at 55½, a net loss of 1⅜, and Metropolitan Street Railway at 122, a gain of 1 point. Interborough Rapid Transit closed at 147, after fluctuating between 145 and 150. Prices in the curb market were very irregular, yet the tone was stronger and most of the active issues closed at net advances. Following are the closing quotations of September 20:

NEW YORK

	Sept. 13	Sept. 20		Sept. 13	Sept. 20
Allis-Chalmers Co.	11	11	Electric Vehicle	15	15⅛
Allis-Chalmers Co. pfd.	48	48	Electric Vehicle pfd.	20	*20
American Tel. & Cable.	89	90	General Electric.	172	169½
American Tel. & Tel.	139	139	Hudson River Tel.	..	..
American Dist. Tel	23	23	Interborough Rap. Tran.	145⅛	145
Brooklyn Rapid Transit.	54⅜	54¼	Metropolitan St. Ry.	121⅝	121⅝
Commercial Cable.	190	190	N. Y. & N. J Tel.	156	..
Electric Boat.	40	37	Marconi Tel.	..	..
Electric Boat pfd.	71	70	Western Union Tel.	91¾	90
Electric Lead Reduction.	*1⅛	*⅛	Westinghouse com	162¾	161
			Westinghouse pfd	180	180

BOSTON

	Sept. 13	Sept. 20		Sept. 13	Sept. 20
American Tel. & Tel.	139	139	Western Tel. & Tel. pfd.	89	90
Cumberland Telephone.	118	118	Mexican Telephone.	1¾	1¾
Edison Elec. Illum.	*260	255	New England Telephone.	130	130
General Electric	171½	168¾	Mass. Elec. Ry.	12¾	13
Western Tel. & Tel.	13	13	Mass. Elec Ry. pfd.	58⅛	60

PHILADELPHIA.

	Sept. 13	Sept. 20		Sept. 13	Sept. 20
American Railways.	48¾	47⅛	Phila. Traction.	97⅝	..
Elec. Storage Battery.	66	64¼	Phila. Electric.	7	7⅛
Elec. Storage Battery pfd.	66	64¼	Phila. Rapid Trans.	16¼	15½
Elec. Co. of America.	9⅛	9⅛			

CHICAGO

	Sept. 13	Sept. 20		Sept. 13	Sept. 20
Central Union Tel.	..	..	National Carbon pfd.	107	*107
Chicago Edison.	..	150	Metropolitan Elev. com.	21⅛	20⅛
Chicago City Ry.	182¼	185	Union Traction.	6	7⅛
Chicago Tel. Co.	122	122	Union Traction pfd.	..	31¼
National Carbon.	35	33			

* Asked

WESTERN UNION REPORT.—The Western Union Telegraph Company made public last week its earnings for the quarter ended September 30. The statement is partly estimated, so far as the month of September is concerned, and is as follows:

	1904.	1903.
Net revenues	$2,100,000	$2,347,196
Interest on bonds	297,550	286,300
Balance	$1,802,450	$2,060,896
Dividend	1,217,019	1,217,017
Surplus	$585,431	$843,879
Previous surplus	14,881,428	13,019,724
Total surplus	$15,466,859	$13,863,603

The earnings for the fiscal year therefore show:

	1904.	1903.
Net revenue	$7,887,474	$8,214,470
Interest on bonds	1,157,700	1,077,700
Balance	$6,729,774	$7,136,770
Dividends	4,868,070	4,868,049
Surplus	$1,861,704	$2,268,721
Previous surplus	13,019,724	10,751,003
Total surplus	$14,881,428	$13,019,724

The regular quarterly dividend of 1¼ per cent. has been declared payable October 15.

BOSTON EDISON FIGURES.—The annual figures of the Edison Electric Illuminating Company, of Boston, for the year ended June 30, 1904, have been filed with the Gas and Electric Light Commissioners. These figures show that company's business last year was the largest and most profitable in its existence. The past year's figures include for the first time the full year's business of the company's suburban properties with the exception of the Somerville and Woburn companies. The Somerville operations are included since January 1, 1904, while the Woburn is still being operated as an independent plant. There was an increase of 15 per cent. in the gross business, while net earnings increased 10 per cent. The statement of earnings we compare as follows:

	1904.	1903.
Increase from sales of light and power	$3,114,623	$2,663,733
Expense of station	576,994	533,732
Expense of distribution	292,251	250,705
Expense of management	276,564	243,583
Expense of taxes and incidentals	909,946	702,435
Total expense	$2,065,756	$1,730,456
Net	1,058,867	933,347
Other income	10,893	36,508
Total net	$1,069,760	$969,855
Interest and miscellaneous charges	84,812	185,508
Balance	$984,948	$784,347
Dividends	973,405	804,667
Surplus	$11,543	Def.$20,320
Previous surplus	40,631	60,951

The $207,511 increase in the item of taxes and incidentals is due to the increase tax account through the acquisition of suburban properties. The decrease of $100,696 in the item of interest and miscellaneous charges is the resultant of the practical elimination of the floating debt during the year through new stock issues. During the year the company increased its capital $1,813,600, making total stock now outstanding $10,444,500.

AMERICAN RAILWAYS COMPANY'S REPORT is issued for the fiscal year ending June 30, 1904. The gross earnings of the subsidiary companies were $1,406,965.44, an increase over 1903 (being a gain of 13 per cent.), of $161,667.94. After paying all fixed charges, interest and taxes, the net income is $270,462.65, a decrease of but $4,229.05 from the previous year, notwithstanding the increased cost of operation due to the increase in the wages of conductors and motormen, and in the cost of fuel. Dividends were paid to the stockholders of the American Railways Company amounting to $234,180, an increase over dividends paid last year of $10,406, leaving a balance of $36,282.65 to be added to the credit of surplus account shown in 1903, of $381,783.15, which makes the balance to the credit of the surplus account on June 30, 1904, $418,065.80. The total number of passengers carried was 31,475,692, being an increase for the year of 3,658,734. The report gives details as to the physical condition and improvement of the Springfield, O., Dayton, O., Altoona, Pa., Bridgeton, N. J., and other properties. Details are also given as to financial transactions in regard to the Altoona and Chicago properties.

FOX RIVER LIGHTING PROPERTIES.—The Milwaukee lighting interests, headed by President John I. Beggs, have voted to purchase all of the preferred and common stock of the Fox River Valley Gas & Electric Light Company and to assume and guarantee all of that company's bonds. The Fox River Company has outstanding $100,000 preferred stock, $300,000 common stock, and $350,000 in 5½ per cent. bonds, maturing in 1921. The company owns the gas plant in the city of Appleton and supplies gas to Neenah and Menasha and owns the electric light plant in the city of Neenah. As soon as the transfer of the stock was consummated the old board of directors tendered its resignation and the following board of directors was elected for the Fox River Company: John I. Beggs, Henry D. Smith, Charles F. Pfister, Frank G. Bigelow and Henry C. Payne. These are the directors of the Wisconsin Company, and they at once elected the following officers: President, John I. Beggs; vice-president, Charles F. Pfister; secretary-treasurer, H. D. Smith. The plant of the Fox River Company is valued at between $600,000 and $700,000.

DIVIDENDS.—A semi-annual dividend of $3 per share has been declared payable October 1, 1904, on the preferred stock of the Seattle Electric Company, to stockholders of record at the close of business September 22. The Cincinnati Street Railway Company directors have declared the regular quarterly dividend of 1½ per cent., payable October 1. The Cincinnati Gas & Electric Company's directors have declared the regular quarterly dividend of 1⅛ per

cent., payable October 1. The directors of the International Steam Pump Company have declared a dividend of ½ of 1 per cent. upon the common stock, payable October 1. The directors also declared the regular quarterly dividend of 1½ per cent. upon the preferred stock, payable November 1. The declaration of a dividend of ½ of 1 per cent. upon the common stock compares with a dividend of 1 per cent. heretofore paid quarterly upon this issue. The company has lately made heavy expenditures on new shops.

WESTINGHOUSE AIR BRAKE COMPANY has issued its annual statement for the year ended July 31, 1904. The income account compares as follows:

	1904.	1903.	1902.	1901.
Net sales of brakes	$5,082,844	$8,452,474	$7,890,831	$7,149,000
Other income	857,109	727,114	668,672	720,857
Total income	$5,939,953	$9,179,588	$8,559,503	$7,869,857
Expenses	3,575,772	5,460,508	5,630,807	4,888,515
Net	$2,364,181	$3,719,080	$2,928,696	$2,981,342
Chgd. off and spl. deprec. fund	26,022	325,506	.....	.....
Surplus	$2,338,159	$3,393,574	$2,928,696	$2,981,342
Dividends	2,417,899	2,636,748	2,634,468	2,792,250
Deficit	$79,740	*$756,826	*$294,228	*$189,092

*Surplus.

The company had cash in hand of over $2,000,000 and a profit and loss surplus of just short of $4,000,000.

BIG TROLLEY PROJECTS.—Pittsburg dispatches state that two big electric railway projects backed mainly by capitalists of that city are to be launched in the near future. One will be known as the Pittsburg & Allegheny Valley Railway, with a capital stock and bond issue amounting to $1,100,000, and the other line will be called the Meyersdale & Salisbury Railway, and will have a capital of $1,500,000.

Commercial Intelligence.

THE WEEK IN TRADE.—Buoyancy in the stock market and stronger prices in cereals had a stimulating influence upon trade, and these and other influences tended to encourage buying. Heavy railroad traffic is reflected in the statements of earnings, roads already reporting for August showing a gain of 3.4 per cent. over last August, and the best on record for that month. The expected activity in iron and steel consequent upon the reduction in finished steel prices did not materialize, but the tone of the crude material market is better. Money is firmer, reflecting the rather belated demand for the purpose of moving crops, and collections show some improvement. In the Northwest frost did some damage to uncut spring wheat, but the corn crop farther south is undamaged, that in Kansas and Missouri being out of danger. Corn is safe in the belt east of the Mississippi. Seventy-five per cent. of the crop is beyond danger. Serious shortage in the spring wheat yield is an admitted fact, the estimate of the total yield ranging from 500,000,000 to 540,000,000 bushels, a decline of over 100,000,000 bushels from a year ago. The corn yield will probably be the second largest ever gathered. Good crop reports come from the Pacific coast, and trade is brisker in that section. At western points there is increased business in iron and steel, hardware, coal and lumber. In the East good trade reports are made. The industrial situation is considerably strained, but in the New York building industry there is talk of harmony being reached. The beef strike is settled, but the strike situation in the Fall River mills is not improved, and the Southern coal miners are still out. Copper was active and strong, closing at 12½ to 12¾c. for Lake; 12⅜ to 12⅝c. for electrolytic and 12⅛ to 12⅜c. for cathodes.

CONCHOS RIVER POWER PLANT.—The construction of the big hydraulic plant on the Conchos River, State of Chihuahua, Mexico, in which the John F. Kelly Engineering Company interests are primarily concerned, is expected to be commenced very shortly, as Mexican advices state that the Department of Communication has granted a Federal concession. Heretofore the franchise of the State of Chihuahua only had been granted, and in order to protect the interests involved in the enterprise it was considered desirable to secure the concession of the Federal authorities as well. The State concession was originally granted to Mr. R. M. Burke, who was United States Consul in Chihuahua under President Cleveland's administration. The Conchos River Power Company has been organized under the laws of New Jersey for the purpose of carrying out the undertaking. Mr. Kelly is president of the company, Mr. Bernard J. Mahony is vice-president, and Mr. W. D. Kloman secretary of the company. The work contemplated involves an early expenditure of $1,000,000, United States currency. The power plant will be situated on the Conchos River, in the vicinity of the Indian village of La Joya. Current will be transmitted to the city of Parral, 44 miles distant, and to the more important city of Chihuahua, 80 miles away. It will also be able to distribute its current within a radius of 100 miles in any direction. The Parral and Chihuahua districts are among the principal mining localities in the southern republic. Besides being an enormous industrial boom to these cities, the plant will have a greatly beneficial influence on the agricultural development of the entire country stretching from the district on the Conchos away to the Rio Grande. This will be accomplished through the system of collecting and storing water during the rainy season which the company has planned. A series of reservoirs will be built where the downpour during the rainy season can be caught and stored up against the coming dry period. The river will thus flow steadily during the dry spell and its general flow will be double that at present in the river.

ORDERS FOR CURTIS TURBINES.—The General Electric Company has orders on its books for about 400,000 kw in Curtis turbines. Up to July 1, 1904, the General Electric Company had shipped 51 large turbines of an aggregate capacity of over 50,000 kw, as follows: 42 500-kw turbines, 60-cycle; 4 1500-kw turbines, 60-cycle; 1 2000-kw turbine, 50-cycle; 1 2000-kw turbine, 25-cycle; 4 500-kw turbines, 25-cycle. The company has shipped abroad on orders seven turbines to England, Japan, South Africa and Cuba. The introduction of the Curtis turbine has been largely responsible for the good showing of the General Electric Company this year when general business conditions were restricted. As the value of a Curtis turbine is $40 per kilowatt the above shipment of 51,000 kw represents a total in sight of $16,000,000 in this branch of the business alone.

NINE HUNDRED-KW PLANT FOR HENRY HEIDE.—The new Henry Heide candy plant, at Vandam and Hudson Streets, New York, is to be equipped with a 900-hp electric plant. There will be two 300-kw direct-current generators direct connected to 450-hp cross compound tandem Corliss engines. The motors to be put in will aggregate about 600 hp in capacity. They will vary from 10-hp to 50-hp each. Mr. C. O. Mailloux, of 76 William Street, is the consulting engineer. Mr. C. J. Goldmark, of 66 New Street, is the electrical engineer.

EQUIPMENT FOR CANADIAN SINGER PLANT.—The Singer Manufacturing Company's huge sewing machine plant to be constructed by James Stewart & Co., of 135 Broadway, at Brunswick, Canada, is to have a 1000-kw electrical plant. The equipment will include two 750-hp compound engines of Corliss type, to be direct connected to two 500-kw direct-current generators. Mr. L. Pine, of the South Bend., Ind., plant of the Singer Manufacturing Company, has the matter in hand.

WARREN TURBINE ORDER.—A Sandusky daily of September 14 says: "A telegram was received Tuesday by the Warren Electric Manufacturing Company notifying it that the $50,000 Government contract for the building of turbine engines for the Boston navy yard has been awarded it. The Warren company has been confident of securing this contract since a bid was filed, although there has been strong opposition. They will be 750-kilowatt machines."

EQUIPMENT FOR LARGE FACTORY.—A large factory is to be constructed at West 37th and 38th Streets, near Tenth Avenue, by Mr. Jacques Kahn, glass importer, 27 Bleecker Street, N. Y. There will be two 125-hp compound engines, direct connected to 90-kw direct-current generators. There will also be 30 motors installed, ranging from 3-hp to 40-hp capacity. Mr. F. A. Maximilian, who is Mr. Kahn's superintendent, will let the contract for the electrical plant.

NEW EDISON STATION, NEW YORK.—Preliminary plans have been filed for a new fireproof power station to be built for the Edison Company on the block on the east side of First Avenue, from Thirty-ninth to Fortieth Streets. It will be three and five stories high, with a facade of granite and brick, and will have a frontage of 197½ feet and a depth of 347.2 feet. Its cost is estimated at $1,200,000, and it will adjoin the present Waterside station.

PRINTING PLANT TO EMPLOY ELECTRICITY.—A big printing plant is to be built at Seventh Avenue and 15th Street, New York, by the publishing house of Street & Smith, of 238 William Street. Mr. James Robert Moore, of 156 Fifth Avenue, has been appointed electrical engineer on the work.

EQUIPMENT FOR CARD FACTORY.—The Consolidated Card Company's factory, at 225 West 13th Street, New York, is to be equipped with a new plant. Mr. J. E. Worthington is purchasing agent of the company.

CONTRACT FOR BELLEVILLE HOSPITAL.—J. T. Finn & Co., 163 Columbus Avenue, New York, have been awarded the contract for the generators, wiring, etc., for the Isolation Hospital at Belleville, N. J.

SOME C & C ORDERS.—The C & C Electric Company, New York, reports that considerable demand has sprung up for small motors, the market for which has been practically dead for three months past. Four 150-kw generators to be direct-connected to Harrisburg-Fleming engines, are to be installed in the Pennsylvania capitol at Harrisburg, Pa. Six slow-speed motors ranging in capacity from 2½ horsepower to 15 horsepower have also been ordered for direct connection to ventilating apparatus for use in the same building. The Electric Carriage Call Company, New York, has placed a contract with the C & C people for 12 special 42-in. ventilating combinationsfor use in the various courtrooms of the New York County Courthouse. The apparatus will be operated by automatic distant-control so arranged that by pushing a button the judges can have the motors run at any desired speed. The Bedford (Ind.) Quarries Company has ordered more C & C equipment, a contract having just come in for two 200-kw generators to be direct-connected to Ide engines. A 50-kw motor generator set has also been ordered. Fifty-five horsepower of motors has been ordered by the Horse Shoe, New York, Forestry Company. These motors will be used for driving sawmill machinery. A 125-kw belted generator is to be shipped to Chicago for use in a big office building there. Seven motors ranging from 5 horsepower to 20 horsepower have been ordered for operating package conveyors at the Hearn department store, New York, the John Wanamaker store in Philadelphia and the Bamberger establishment at Newark, N. J. Several C & C motors have also been ordered by the United States Navy Department for driving machine tools in various navy yards. The Camden, N. J. courthouse is to have six motors varying from one to 20 horsepower for operating heating, ventilating and pumping apparatus. Five small belted generators have been requisitioned for installation in isolated lighting plants in Louisiana. This order came through the Standard Electric Company, of New Orleans, which concern represents the C & C in that territory.

POWER AT QUEBEC, CAN.—The Quebec Electric Company is starting work on the installation of its plant at Ste. Anne and Seven Falls. The technical work of the engineers employed by the company has been completed, plans all drafted, the work of organization consummated, and the construction of the dams necessary, and the foundation work in connection with the power houses, at each of the falls, secured by the company, commenced with the least possible delay. The engineers employed by the Quebec Electric Company to survey and report upon the water power and possibilities of the Ste. Anne and Seven Falls properties were Messrs. E. Gauvin, C. E., of the Provincial Crown Lands Department, and Mr. Beaudry Leman, C. E., chief engineer and general manager of the Shawinigan Falls Water Power Company. The Seven Falls are specially alluded to in their report as being a great and valuable acquisition, on account of their central location for which they are required. The engineers also pay particular attention in their report to the commercial value of Ste. Anne Falls as an adjunct to the former and make it clear to the company that it has little or no obstacles to encounter in promotion of its enterprise. The Seven Falls are much higher than the Falls of Montmorency. They attain an elevation of 400 feet, but the engineers will take the water at an elevation of 374 feet. These falls will develop at low water from 12,000 to 15,000 hp, and the Ste. Anne Falls, a short distance away, 10,000 hp. or, consolidated 22,000 to 25,000 hp. Mr. A. R. McDonald, of Quebec, is financially interested in the enterprise.

GOULDS PUMP WORKS ENLARGED.—The Goulds Manufacturing Company, of Seneca Falls, N. Y., has just purchased additional land at that point, and a local paper says: "It undoubtedly means the enlargement, extension and concentration of the entire works of the Goulds Manufacturing Company along the line of the Central Railroad. The necessity for increased and more convenient facilities for manufacturing has been felt by the company for a long time past, and it is not surprising that it is availing itself of all the advantages of modern methods for manufacturing. The No. 2 works of the company, as large and efficient and well equipped as they are, are totally inadequate to meet the demand for the products of the company. Should the Lehigh Valley Railroad fulfill its option of purchasing the present large warehouse of the company in Bayard Street, as is now contemplated, the facilities of the concern would be so reduced as to require the removal of much of its machinery to other and better quarters. The whole scheme of enlargement contemplated by the Goulds is on an extensive scale, and, when completed, will add greatly to the manufacturing interests of the town. It will also place the concern foremost among the largest manufacturing establishments of the country. The dominant force in this project of enlargement is Mr. S. S. Gould, president of the company, who has exhibited a degree of aptitude and ability in the management of the business of the company most gratifying to the people of Seneca Falls."

ELEVATED TO CARRY FREIGHT.—The United States Express Company has completed arrangements with the Interborough Rapid Transit Company, of New York City, for carrying express matter on elevated railroad trains from the Battery to Harlem. Heretofore whatever matter was addressed for Harlem has been sent on wagons, and throughout upper Manhattan and the Bronx has been handled by the Borough Express Company. All matter received at the downtown offices for points above Fifty-ninth Street will be handled on the elevated. For this purpose the railroad company has provided a number of special cars, which will not be attached to passenger cars, but will be drawn by motor cars. To prevent interruption of the passenger traffic, express matter will not be handled at passenger stations, but at storage yards and on sidings. Express matter will be placed on elevated trains at the side track adjoining an elevator at the foot of Trinity Place, near the junction of Morris and Greenwich Streets. From that point a train can be sent to South Ferry and switched over onto the tracks of the Second or Third Avenue divisions, or can proceed uptown on the Six or Ninth Avenue divisions. All matter collected at the uptown stations will be taken from the elevated trains at this point.

LARGE MAGNETO COIL LOCAL BATTERY SWITCHBOARD INSTALLATION.—The general trend of the independent operator is to equip his exchange with central energy apparatus, particularly where an exchange reaches over 300 or 400 lines immediate capacity and is expected to exceed, at some future time, 800 or 900 lines capacity. As an exception to the rule, however, the recent equipment ordered by the independent company at Beloit, Kan., and installed by the American Electric Telephone Company, of Chicago, serves as an indication that there are still those who favor the magneto system. A recent shipment made by the American Company consisted of a 500-line "Bell Express" board built up in two sections of three positions each. This switchboard is provided with very complete arrangement for rendering toll service, and the trunking circuits are so arranged as to operate in conjunction with a specially equipped toll line switchboard. The magneto board is arranged for an ultimate of 1200 lines, and each position of the switchboard may be equipped with 200 lines. The local trunking service between the operators is accomplished over the usual lamp transfer system.

MEXICAN WATER POWER CONCESSIONS.—Mexican advices state that the water power concessions which permit of the utilization of water from certain portions of the Santiago River, near Tolotlan, State of Jalisco, and owned by Leon Pegot and Manuel and Miguel Quenedo, have been consolidated, and now form one large project. This combination gives the concessionaries a water right of 15,000 liters per second, and they purpose to harness and transmit the energy to the cities of Guadalajara and Agua Calientes.

THE SMITH STORAGE BATTERY COMPANY, Binghamton, N. Y., has received an order for a 200-amp-hour battery to be installed in an electric lighting plant on a large ranch in the State of Sonora, Mexico. The company is also furnishing a 55-tray battery with a capacity of 280 amp hour at 110 volts to the Ball & Socket Manufacturing Company, Cheshire, Conn. Among other recent orders are batteries for the University of Texas and the State Agricultural College of Michigan.

CONTRACT FOR MEXICAN LIGHTING PLANT.—Mexican advices state that the electrical engineering and contracting firm of Van Voorhis Brothers, of Monterey, State of Nuevo Leon, which handles considerable American equipment, has been awarded a contract by Berlanga Brothers, of Montemorelos, State of Nuevo Leon, for the construction and equipment of a water power electric plant.

TURBINES FOR RAILWAYS.—It is stated that the Boston & Northern Street Railway Company electric system last week placed an order with the General Electric Company for five 500-kw. direct-current turbines, following out its plans for reducing its power costs. This order involves about $100,000.

POWER PLANT FOR AMECA.—Ameca, a good sized town located in the State of Jalisco, Mexico, is to have an electric light and power plant. Mr. Aurelio Reyes, who operates a large alcohol factory in that place, has secured the contract. He will utilize electric power from the plant to work his distillery.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., expects to be in the market shortly for an engine-type generator, together with engine, of about 75-kw. capacity, 110 volts. It will be glad to hear from manufacturers on the subject.

TELEPHONE SYSTEM FOR PRETORIA.—Some $65,000 is to be expended for the installation of an up-to-date telephone system in the city of Pretoria, Transvaal, South Africa.

General News.

THE TELEPHONE.

BIRMINGHAM, ALA.—The People's Telephone Exchange here was recently destroyed by fire.

MONTGOMERY, ALA.—The Enterprise Telephone Company, capital $15,000, has filed papers of incorporation with the Secretary of State at Montgomery.

SAN FRANCISCO, CAL.—The Pacific States Telephone & Telegraph Company will erect a new building here at a cost of about $100,000.

SAN FRANCISCO, CAL.—The Postal Telegraph-Cable Company has announced that it is ready to accept business for Sitka, Juneau, Haines Mission and Skagway, Alaska, at greatly reduced rates, via the new Government cable between Seattle and Sitka.

TALLAHASSEE, FLA.—A new telephone company is being formed at Eustis City with a capital stock of $2500. It is being organized by H. G. Whitsett, H. W. Bishop and others.

JACKSONVILLE, FLA.—The property of the Jacksonville, Fla., Telephone Company has been sold at auction to G. K. Gerow for $5000, Mr. Gerow being supposed to represent the principal creditors. About $75,000 has been invested in the property, which was organized to compete with the Southern Bell Telephone Company. It is not known whether or not the exchange will be continued.

ATLANTA, GA.—The Georgia Telephone Company has asked permission to install a local and a long distance system in the city of Athens, Ga. The company has already secured franchises at Union Point and Madison, and with the independent exchange at Covington it expects to reach Atlanta in this manner.

SHELBYVILLE, ILL.—Another telephone company has been organized here to be known as the Mutual Telephone Company No. 3. D. B. Yantis was elected president.

FINDLEY, ILL.—The East Okaw Mutual Telephone Company, of Findley, has been incorporated with a capital stock of $600. The incorporators are Jas. E. Francisco, Archibald M. Lesley and Curtis Spicer.

NASHVILLE, ILL.—The Southern Union Telephone Company, of this city, has disposed of all its lines in Coulterville to the Coulterville Telephone Company. The new company has organized with the following officers: President, J. I. Higgs; secretary, C. N. Laubenheim; treasurer, R. M. Burns. The company will proceed to extend the line to Marissa and secure connection into St. Louis over the lines of the Bell Company.

EDINBURG, IND.—The Citizens' Telephone Company has increased its capital stock from $3000 to $9000. The directors are Nathaniel Moroney, John R. Mutz and John M. Breeding.

UNIONVILLE, IND.—The Unionville Telephone Company has been incorporated with a capital stock of $399. The directors are George W. Welch, Milford Young, P. F. Lincicome and W. J. Slater.

VIELE, IA.—The Viele Independent Telephone Company, of Lee County, has filed articles of incorporation. Its capital stock is $3000. R. C. Conlee and others are the incorporators.

ARGENTINE, KAN.—W. A. Strickland. of Turner, Kan., who now operates an independent telephone system along the Kaw Valley which is patronized by 100 farmers living between Turner and Argentine, will ask the council of the latter city at its next meeting to grant him a franchise to extend the system into Argentine. Many of the Argentine merchants have already expressed themselves in favor of the franchise being granted.

PENTWATER, MICH.—An automatic telephone system is being installed here at a cost of $3000.

GRAND LEDGE, MICH.—The Grand Ledge Telephone Company has been incorporated with a capital stock of $10,000.

GREGORY, MICH.—The farmers of the neighborhood will build a telephone line from Gregory to Chelsea, adding 260 more subscribers with whom the Chelsea exchange will have direct communication.

MORRILL, MINN.—The Morrill Rural Telephone Company has been incorporated with a capital stock of $50,000.

STILLWATER, MINN.—The Twin Lake Rural Telephone Company has been formed in the towns of Stillwater and Grant.

ALBERT LEA, MINN.—The Albert Lea Telephone Company has just placed an order with the Kellogg Switchboard & Supply Company for an entire new outfit for its exchange here. It is expected that the new plant will be ready to install in 30 days.

ZUMBRO FALLS, MINN.—The Zumbro Falls Farmers' Telephone Company has been incorporated with a capital stock of $7000. The incorporators are Frank Robertson, Bert W. Disney, Chas. Anding, Albert Sugg, Albert Roberson, John C. Brinkman, Jas. Ross and Jacob J. Springer.

OKOLONA, MISS.—The Cumberland Telephone Company has bought out all the local companies in Chickasaw County and will install an up-to-date service all over the county, having exchanges both in Okolona and Houston.

GRAINFIELD, MO.—The Gove County Telephone Company has been incorporated with a capital stock of $5000.

HASTINGS, NEB.—The Hastings Independent Telephone Company is to erect a new $10,000 building.

JERSEY CITY, N. J.—The Dixon Home Telephone Company has been incorporated with a capital stock of $125,000. The incorporators are Chas. N King, W. Monds Green and Elmer H. Geran.

JERSEY CITY, N. J.—The Underhill Telegraph Translator Company has been incorporated with a capital stock of $100,000. The incorporators are Harry F. Hayward, Marshall McLean and Willard C. Fisk.

STAMFORD, N. Y.—The Delaware & Schoharie Telephone Company has been incorporated with a capital stock of $2000. The directors are H. P. Hubbell, E. W. Landen and others.

BUFFALO, N. Y.—The Century Telephone Construction Company has been incorporated with a capital stock of $500,000. The directors are B. G. Hubel, Martin Coney and Theodore S. Fassett.

NEW YORK, N. Y.—The International Telegraph Construction Company has been incorporated with a capital stock of $100,000. The directors are H. H. Kurtz, C. H. Baechtold and G. A. Kuhirt.

ROMULUS, N. Y.—The McDougal Telephone Company has been organized with Addison Baldwin, president; R. C. Allen, vice-president; Clarence G. Updike, secretary, and Alexander Balbridge, treasurer.

WELDON, N. C.—The Home Telephone Company and the long distance Bell Telephone lines at Weldon, are preparing to rebuild the local system, installing cables, etc. F. C. Toeplemann is the general manager.

KENTON, OHIO.—Owing to the increase in toll business the Kenton Telephone Company will shortly install a new two-position toll board and will then employ two toll operators.

JUNCTION CITY, OHIO.—The Rushcreek Telephone Company has been incorporated with a capital stock of $5000. The incorporators are W. S. Tuttle, J. M. Elder, Jos. M. Folk and S. C. Elder.

NEWCASTLE, OHIO.—The Newcastle Telephone Company has been incorporated with a capital stock of $3000. The incorporators are J. W. Dillon, Abe Horn, W. L. Berry, W. C. Wilson and W. S. Crater.

TUSCARAWAS, OHIO.—The Tuscarawas Valley Telephone Company has been incorporated with a capital stock of $2000. The incorporators are Earl D. Fisher, John W. Keel, C. J. Pfau, S. B. Ennis and H. L. Fisher.

DRYDEN, OKLA.—The Dryden Telephone Company has been incorporated with a capital stock of $1100. The incorporators are J. S. Campbell, B. D. Perry and J. S. Wilkins.

WILLAMETTE, ORE.—The West Oregon Telephone Company proposes to conduct a general telephone business with headquarters here. The company has a capital of $2000. Those interested are Chas. Baker, G. P. Cross and S. S. Kruse.

BAKER CITY, ORE.—The Pacific States Telephone & Telegraph Company will make extensive improvements to its system in Baker City, Eastern Oregon and the long distance service. The plant here will be rebuilt and a common battery system installed. New copper wires will be strung.

ERIE, PA.—The Union Telephone Company has been incorporated with a capital stock of $10,000.

EDINBORO, PA.—The Edinboro Telephone Company has been incorporated with a capital stock of $6000.

PITTSBURG, PA.—The Pittsburg-Butler Telephone Company has been incorporated with a capital of $25,000.

COUDERSPORT, PA.—The Allegheny Valley Telephone Company has been incorporated with a capital stock of $5000.

HERNDON, PA.—The Mahoney-Mahantango Telephone Company has been incorporated with a capital stock of $20,000.

BATESBURG, S. C.—The Batesburg Telephone Company has been formally organized with William Westmoreland, of Samaria, president, and Dr. J. A. Watson, secretary and treasurer. The capital is $500.

FLORENCE, S. C.—An interesting legal fight is in sight at Florence where the Southern Bell., which purchased the Home exchange, is charging tolls without having complied with the new State law, it is alleged, requiring the company to apply to the State Railroad Commission, giving reasons for changing rates, etc.

FREDERICKSBURG, VA.—The Toluca & Fredericksburg Telephone Company, of Stafford Courthouse, has been incorporated with a capital stock of $1000 to $5000. The incorporators are R. A. Moncour, Hugh Adie, T. G. Waller, T. J. Moore and Welsey Knight.

CLARKSTON, WASH.—The Clarkston Independent Telephone Company has been incorporated with F. J. Randolph, Peter Hendricks, T. A. Temple, Fred A. Hinkley and Greenville Holbrook as trustees.

PINE CITY, WASH.—The Interstate Telephone & Telegraph Company has been incorporated with a capital stock of $5000. The incorporators are J. J. Stephens and Nelson Howard, of Thornton, and Dr. T. A. Swan, of Pine City.

COLFAX, WASH.—The Interstate Telegraph & Telephone Company has filed articles of incorporation, the capitalization being $5000. J. J. Stephens, of Thornton, is named as president of the company.

TACOMA, WASH.—Considerable agitation is being aroused over a franchise now before the City Council regarding an independent telephone system for the city. It is understood that the Home Telephone Company of Los Angeles, Cal., is backing the new company.

BELLINGHAM, WASH.—The British Columbia Telephone Company made a new proposition regarding the building of a line from Victoria to Bellingham, Wash. It provides that the United States Government shall, for the period of two years, pay a fixed amount in tolls.

GREEN BAY, WIS.—The Valley Telephone & Telegraph Company has been granted a franchise to operate an independent telephone system. It is proposed to expend $200,000 on the new system.

BRANTFORD, ONT.—The city of Brantford has decided to instal a civic telephone service. The estimated cost is $37,000, for which it is expected that business telephones will be given for $25 per annum and house telephones for $12.

ELECTRIC LIGHT AND POWER.

SEARCY, ARK.—Bids for the construction of an electric light plant will not be opened until about Oct. 10. The estimated cost is $22,000.

SAN FRANCISCO, CAL.—The Big Creek Power Company which maintains a water power electric transmission plant at Swanton and supplies Santa Cruz, Cal., with light and power, was crippled for several days by the burning of a portion of its flume by a forest fire. The company's new steam power generating station at Watsonville was placed in operation Sept. 10, and the electric cars at Santa Cruz then resumed operations. The city now has electric lights as usual. Oil fuel is used at the new Watsonville plant, which is equipped with a Westinghouse 1280-kw, 3-phase, 11,000-volt generator, direct connected to a McIntosh & Seymour engine.

SALIDA, COL.—A chart of preliminary plans and specifications for a water power electric plant is now in the hands of the Edison Electric Light Company and as soon as a site for the plant can be determined upon, work will be commenced. The present plan is to install a plant with a capacity of 2000 horse-power.

WASHINGTON, D. C.—Bids will be received Oct. 4 at the Bureau of Supplies and Accounts, Navy Department, Washington, for furnishing at the navy yards, Pensacola, Fla., Key West, Fla., and New Orleans, La., a quantity of incandescent lamps, wire, miscellaneous electrical supplies, sheet steel, copper pipe, installing electric conduit, subway, etc. Address H. T. B. Harris, Paymaster-General, U. S. N.

LA GRANGE, GA.—A bond election was held in La Grange recently and $25,000 was voted for an electric light plant.

DUBLIN, GA.—The town of Dublin will hold an election on October 10 on the question of issuing $45,000 bonds for lights and other improvements.

MACON, GA.—The Macon Fair Association has about decided to contract with the Macon Railway Company to supply lights for the coming state fair, in lieu of putting in a private plant.

WAYNESBORO, GA.—The franchise has been let and an election called to vote on bonds for an electric light plant at Waynesboro. The new plant will probably be in operation by January 1.

ATLANTA, GA.—The work on the big dam of the Atlanta Water & Electric Power Company across the Chattahoochee River, at Bull Sluice, has been completed. The pole lines are built and will deliver the current to the Georgia Railway & Electric Company, which has contracted for the entire power generated at the new dam.

WAYNETOWN, IDA.—Mr. E. S. Aldrich and Mr. P. Greer have sold the electric light plant here to Mr. Thomas Wievallen, who intends building a sawmill in connection with the plant.

MOSCOW, IDA.—Mr. E. S. Aldrich and Mr. M. J. Shields, of Moscow, and Mr. Garnet P. Grant, of Rossland, B. C., will build an electric light plant at Macleod, Alberta. They will install a 2000-light plant, consisting of an Atlas high-pressure boiler, Ball compound engine and Stanley alternator. They expect to have the plant in operation about November 15.

LEWISTON, IDA.—The Lewiston Water & Power Company is building transmission lines to Uniontown, Genesee, Moscow and Pullman. This company, the Lewiston Light Company, Ltd., the Clarkston Water Works and other interests are being combined into the new Lewiston-Clarkston Company and the capital has been increased to $3,000,000. The new company is now building a 1000-hp auxiliary steam plant and contemplates the extension of its lines to four other towns 40 miles distant, and to mines and factories for power. The company also contemplates enlarging its water-electric power plants to 5000-hp.

MOSCOW, IDA.—Mr. E. S. Aldrich, manager of the Moscow Electric Light & Power Company, states that they will have the plant in Genesee completed about Oct. 20, and will operate a day and night service for power and light, getting their power for the transmission system of the Lewiston Water Power Company. This power will be used to operate the pumps of the new city water works plant and also to run the large flouring mills, machine shops, etc., both at Genesee and Moscow. It is also expected that the system will be extended to Uniontown, Colton and Pullman, Wash. The Lewiston Water Power Company is installing, as a reserve power, a 750-hp Parsons steam turbine, direct connected to a Westinghouse revolving field alternator, this being one of the first turbine installations west of the Rockies. About 50 miles of line are now being constructed, the line being three-phase, the transformers and sub-stations being designed for 44,500 volts, but connected for the present at 22,000 volts. The Grand Round River will be used to develop a plant of about 10,000 horse-power, which will be transmitted to all towns in the Palouse country and distributed by the Moscow Electric Light & Power Company, which has contracted for this power for the next ten years.

KENDALLVILLE, IND.—It is reported that the city will expend $4550 in new electric street lighting equipment. The system will have 80 arc lights, an increase of 25.

NEW ALBANY, IND.—The stockholders of the United Gas & Electric Company have decided to issue $750,000 bonds to be used for the extension and improvement of plants in this city and Jeffersonville, and to acquire and improve plants elsewhere.

INDIANAPOLIS, IND.—Edward L. McKee has been elected president of the Merchants' Heat & Light Company, to succeed Wm. C. Bobbs, resigned. The improvements now under way will increase the capacity of the plant two and one half times. Mr. Bobbs will remain chairman of the board of directors.

ANDERSON, IND.—Members of the board of trustees of the Municipal Electric Light Plant have been served with a temporary injunction restraining them from further removal of meters from customers of the light plant, who refuse to deposit $5 as a guarantee to payment of light bills, as ordered by the board. Dr. M. V. Hunt, John H. Terhune and others are the petitioners.

SUMNER, IA.—The citizens have voted to grant a franchise to construct an electric light plant. Walsh Bros. have petitioned for a franchise.

DES MOINES, IA.—It is stated that the Iowa Light, Heat & Power Company proposes to expend about $125,000 on improvements to and extensions of its service next year.

MADRID, IA.—The Madrid Electric Light & Power Company has amended its articles of incorporation to make the capital stock $15,000. A. P. Z. Westerberg is president of the company.

BANGOR, ME.—A. R. Gould, of Presque Isle, writes that contracts will probably be let next March for the work in connection with construction of a dam and the development of about 3000 horse-power at Aroostook Falls.

UNION CITY, MICH.—The Council is considering the purchase of a new engine and boiler for the power house.

GRAND RAPIDS, MICH.—The Board of Public Works has decided to readvertise for bids for machinery for the lighting station.

WAYNE, MICH.—John Fitzgibbons, Jr., Village Clerk, writes that it was voted to issue bonds for the construction of an electric light plant there.

GREENWOOD, MISS.—Bonds to the amount of $123,000 have been sold, to be used to pay for the plant of the Water, Sewerage & Electric Light Company.

ST. JOSEPH, MO.—Bonds to the amount of $75,000 have been sold, to be used for the construction of an electric light plant.

ST. LOUIS, MO.—All the wire-using companies of the city have been notified by the supervisor of city lighting that on September 12 his force will commence cutting down all wires which are found unlawfully above ground in the underground district, and all wires in all parts of the city which are dead or which have been strung without a permit.

LOCKPORT, N. Y.—The Council has under consideration the granting of a franchise to the New Netherlands Gas & Oil Company to establish and operate a system for furnishing natural gas and electricity in this city.

CHARLOTTE, N. C.—Hook & Sawyer are preparing plans and specifications for the erection of a power house for the Catawba Power Company.

[illegible] N. C.—J. L. Peacock, clerk, will receive bids during the remainder of the month, for the erection of an electric lighting plant for the town, embracing two 85-hp engines and two 60-kw alternating-current generators.

SIDNEY, OHIO.—The Sidney Light, Heat & Power Company will probably need two 200-kw 3-phase belted generators, simple Corliss engines and return tubular boilers. Fred W. C. Bailey, Columbus, is the engineer.

SPRINGFIELD, OHIO.—The American Railways Company, which controls the Springfield Railway and the Springfield Light & Power Company, has decided to rebuild the electric light plant next year at a cost of $100,000.

NEWARK, OHIO.—The Newark Heat & Light Company has been incorporated with a capital stock of $10,000. The incorporators are Augustus H. Heiser, Geo. M. Heiser, E. W. Heiser, Geo. Graeser and James Fitzgibbons.

PENDLETON, ORE.—The Echo Water, Light & Power Company has been incorporated, with a capital of $10,000, to construct an electric plant.

LANCASTER, PA.—The Millstone Water & Power Company, of Lancaster, is interested in the construction of a power plant at Lancaster.

SHENANDOAH, PA.—The Borough Council has awarded the contract for street lighting to the new People's Electric Light, Heat & Power Company at $63.50 per light per year for three years, the contract to take effect Jan. 1, 1905.

DALE, PA.—The Dale Light, Heat & Power Company has been organized, with Geo. E. Daniels, president, and Lincoln Messenger, secretary, and has secured from the Borough Council a right of way over the streets. The power house will be erected on Bedford Street.

LAURENS, S. C.—The town of Laurens has voted $40,000 bonds for an electric light and sewer plants.

CLINTON, S. C.—The citizens have voted to issue $25,000 bonds for the construction of water works and an electric light plant.

DAYTON, TENN.—The electric light plant owned by Thos. E. Stone has been destroyed by fire. The plant was recently completed, at a cost of $5000.

STEVENS POINT, VA.—Adolph Green, of Green Bay, has secured the contract for the construction of a water power plant, to furnish electricity for the lighting of the city, at a cost of $18,000.

SEATTLE, WASH.—A $300,000 bond issue to extend the city lighting system will be deferred until spring.

ELLENSBURG, WASH.—The bond issue of $25,000, recently voted for an electric light plant, will be taken up by the Washington State Bank of this city. The design is to have the plant, which will be operated by water power, ready for operation early in November.

NEW WESTMINSTER, B. C.—F. J. Fader, of New Westminster, is interested in the Harrison Lake Power Company, which proposes constructing a power plant to utilize 30,000 horse-power from Rainbow Falls.

PRESTON, ONT.—The citizens have voted to establish a municipal lighting plant.

THAMESVILLE, ONT.—The citizens have decided to construct water works and an electric light plant.

NORTH BAY, ONT.—Mr. A. F. Legatt, of Ottawa, has purchased the electric light franchise and plant in the town of North Bay. The gas and electric business will be combined. The electric plant has been established in the town for ten years and has an exclusive franchise.

NIAGARA FALLS, ONT.—It is stated that the Toronto & Niagara Power Company, which is constructing a plant for the development of current to be transmitted to Toronto, has let a contract to the I. P. Morris Company, of

Philadelphia, Pa., for four water turbines of 10,000 horse-power each. They will be direct-connected to 7500-kw generators, to be built by the Canadian General Electric Company. F. S. Pearson, 29 Broadway, New York, is chief consulting engineer of the Toronto & Niagara Power Company.

QUEBEC, QUE.—The financial statement of the Quebec Railway, Light & Power Company shows the net earnings of the system to be $22,079 over the previous year. The unusual severity of last winter, together with the heavy falls of snow, caused an increase in the expenditures for operating expenses. The present board of directors was re-elected, the personnel of which is as follows: Mr. A. Thompson, president; Mr. Frank Ross, vice-president, and Hon. J. Sharples, Hon. S. N. Parent, E. W. Methot, W. Shaw, W. Hanson, G. F. Thomson and F. W. Ross, directors. Mr. E. A. Evans is the general manager and chief engineer.

MONTREAL, QUE.—The Shawinigan Water & Power Company, of Shawinigan Falls, Que., announces that it will be in a position to deliver 10,000 additional horse-power into Montreal on December 1 next. This large undertaking, which entails the erection of another transmission line all the way from Shawinigan to Montreal, upwards of 80 miles, will also require the installation, both at Shawinigan Falls and at the Maisonneuve station in Montreal, of particularly large and improved machinery. At Shawinigan a new large penstock is being erected from bulkhead to power house, which will have a capacity of 11,000 horse-power. The water wheel, which is being installed by the I. P. Morris Company, of Philadelphia, Pa., is said to be the largest wheel ever built and will have a capacity of 10,500 horse-power. The generators, which are being installed by the Westinghouse Company, will have a capacity of 6600-kw. and the transformers a capacity of 4400-kw. By existing contracts, the Montreal Light, Heat & Power Company takes all the electric power brought into Montreal by the Shawinigan Company.

THE ELECTRIC RAILWAY.

WATSONVILLE, CAL.—The Watsonville Transportation Company has voted to issue $200,000 in bonds to run thirty years. All preliminary arrangements have been made for the extension of the line to Vega.

ROCKVILLE, CONN.—Preliminary plans for the Rockville, Broad Brook & East Windsor Street Railway Company have been nearly completed. The company is capitalized at $100,000. All local franchises and rights of way have been secured, and the contract for building the line will soon be awarded.

DYERSVILLE, IA.—The Dyersville & Northern Railway Company has been incorporated to build an electric railway to New Vienna. Capital stock $75,000.

DETROIT, MICH.—J. D. Hawks, president of the Detroit, Ypsilanti, Ann Arbor & Jackson Railroad, confirmed the report that a new electric line will be built between Jackson and Lansing. He said the surveys will probably be completed this fall, and construction start early in the spring. Several routes are under consideration. This line will be a part of a system of lines in Southern Michigan, now being welded into shape by the Ypsilanti-Ann Arbor interests and W. N. Coler & Company, of New York.

CHARLOTTE, N. C.—The Highland Park Manufacturing Company of Charlotte, a large cotton mill company, contemplates building an electric railway system in the suburban town where the plant is located.

HIGH POINT, N. C.—The High Point Interurban Traction Company has applied for a franchise in High Point, with a capital of $300,000. W. A. Heller, of Danville, Pa., is interested. It is proposed also to build lines connecting Greensboro, 16 miles distant, and Winston-Salem, 25 miles distant. At a meeting in Philadelphia, of the parties interested in the new electric railway 20 miles long, starting at High Point, the plans were approved. A movement is taking shape to ask the company, the High Point Interburban Company, to extend the line to Yadkin County and it is said that the people along the way will give $100,000 toward the project.

EAST LIVERPOOL, OHIO.—The City Council is advertising for bids for a twenty-five-year franchise for a new electric railway.

STEUBENVILLE, OHIO.—The Council has granted the Steubenville & Wheeling Traction Company a franchise for a line from Steubenville to Mingo Junction. A line between these points is already in operation. The new line will reduce the running time.

CINCINNATI, OHIO.—The Tennis Railway Construction Company has the contract for building a line from Evansville to Newburg, Ind. C. C. Tennis, president of the company, states that $500,000 of bonds have been sold for a further extension of the line.

MARION, OHIO.—The Marion, Bucyrus & Tiffin Railway & Light Company has been formed by the combination of several interests which have projected lines between Marion, Bucyrus and Tiffin. Ellis Bartholomew, of Toledo, and Judge C. Ernhart, of Columbus, are among the prime movers of the project. It is claimed that arrangements for financing the project have been made.

COLUMBUS, OHIO.—The Coler syndicate, of New York, and Gay Brothers, of Boston, are reported to have arranged for the financing of the Cleveland, Wooster, Mount Vernon & Columbus Electric Railway. The project has been in the air for some time. The plan is to build a line from Columbus to Wooster, where connection would be made with the Cleveland & Southwestern system, affording a direct route from Cleveland to Columbus.

TOLEDO, OHIO.—C. H. Masters, secretary of the Toledo & Indiana Railway Company, announces that the permanent power station of the company will be erected at Stryker. The present temporary power station is at Delta. A number of towns have been making a strong fight to secure the permanent station. The company is now at work securing the right of way for the extension of the line from Bryan to Fort Wayne, Ind., the ultimate terminus of the line.

EUGENE, ORE.—The construction of an electric railway connecting this city with Coos Bay is planned by the Willamette Valley Electric Railway Company. Congressman John F. Wilson, of Arizona, is at the head of the enterprise.

WEST CHESTER, PA.—A tract of land has just been purchased in Willistown Township by the Philadelphia & West Chester Traction Company, on which will be erected a new power house to cost $150,000, including machinery.

NORRISTOWN, PA.—Deeds for the 14-mile extension of the Souderton, Skippack & Fairview Electric Railway Company have been filed here for record.

SIOUX FALLS, S. D.—S. C. Lee, A. H. Marshall, W. R. Marshall and others, of Des Moines, Ia., have secured a franchise for a street railway and heating plant.

EUREKA, UTAH.—Jackson McChrystal and Philip Clark, of Eureka, have petitioned the Council for a franchise to operate an electric light and railway system here.

NORFOLK, VA.—The Norfolk City & Suburban Railroad Company has awarded a contract to the Standard Electric Company for the construction of an electric railway between Norfolk and the property of the Wheeling Development Company, near Indian River Gardens, a distance of 3½ miles. The officers of the Norfolk City & Suburban Company are James G. McNeal, president; L. W. Davis, vice-president; State Senator Finley Cromwell, secretary and treasurer.

FAIRMONT, W. VA.—The Fairmont & Morgantown Traction Company has been incorporated, with a capital stock of $50,000, by C. L. Barnes, W. T. Watson, John Pope and T. T. Holt, most all of whom are citizens of the city. The company proposes first to construct a line from Fairmont to Montana, a coal town 5 miles from here. Later the line wil be extended to Morgantown.

WASHBURN, WIS.—An electric railway is projected from this city to Barksdale, 5 miles below where the Atlantic Manufacturing Company has located its large plant.

PERSONAL.

MR. W. W. NICHOLS.

MR. W. W. NICHOLS.—This gentleman, who has just been made vice-president of the Allis-Chalmers Company, and whose portrait is presented herewith, graduated in mechanical engineering at the Sheffield Scientific School of Yale University. He then entered railway shops at Cleveland to serve a special apprenticeship and in other ways preparatory to a post graduate degree of M. E. of Yale, which was later conferred. He then became assistant engineer of tests for the Chicago, Burlington & Quincy Railroad and later on was made assistant master mechanic of the Chicago division. His efficiency and versatility led to his being made superintendent of telegraph for the system, and from this position he graduated into the electrical field proper, becoming the superintendent of the Chicago Telephone Company. Mr. Nichols found that this was extremely exacting work, and after two years of close attention to the details of direction, manipulation and organization of what has been aptly described as "the nervous system of the most nervous community on earth," and just prior to the World's Fair, he found it was necessary to take a long rest free from all business responsibility. Mr. Nichols next returned to Yale as an instructor, and for several years there he gave advanced courses in engineering, his principal specialties being steam and hydraulics. Although highly successful as an educator the attractions of work in the practical field were once more too strong for him, and he became the assistant manager of the Baltimore Copper Smelting & Refining Company. From this business he was called to be assistant to the chairman of the executive committee and the president of the Allis-Chalmers Company. His efficient work in this capacity has now led to his appointment as vice-president of this company at the time of its development in the electrical field and as a great producer of apparatus utilizing all the four powers. It may be mentioned that Mr. Nichols is a member of the American Society of Mechanical Engineers, a fact of interest as bearing upon the important mechanical engineering problems in various fields that are now brought to the Allis-Chalmers Company for its determination.

MR. J. B. SMITH has been appointed city electrician of Jackson, Miss. The office is a newly-created one.

MR. R. G. ROUTLEDGE, formerly of Thomas F. Smith Company, New York, now out of business, has taken charge of the contract department of the H. W. Johns-Manville Company, New York City.

PROF. ROBERT SIBLEY, who is at the head of the electrical engineering department of the University of Montana, was recently married to Miss Ada Catherine Stone, at Berkeley, Cal. Prof. Sibley is a recent graduate of the University of California.

MR. M. J. FRANCISCO, past president of the National Electric Light Association, has been very ill this year, but his friends will be glad to learn that now, after an absence of eight months, he has been able to return to his office in Rutland, Vt., where he lives.

MR. CHARLES R. HEAP, of London, who handles considerable American electrical equipment, machine tools, etc., for the British markets, has sailed for Europe after several weeks' visit to this side. Mr. Heap takes care of the British interests of the C & C Electric Company.

MR. F. G. McPEAK, superintendent, of the southern division of the De Forest system, announces the successful operation of the stations at Fort Worth

and Dallas, the first wireless operations in Texas. It is planned to establish an overland service to the Pacific coast from Fort Worth by way of Mexico.

DR. P. HÉROULT, of La Praz, France, the inventor of the electrical smelting process, has been in Ottawa, Can., recently. It is understood that he has completed arrangements with local capitalists for the development of large iron deposits near Ottawa. Electric smelting works will be established and will be operated by electricity developed from Chats Falls.

MR. J. F. MORRISON, of Baltimore, Md., for years past was collecting with enthusiasm and judgment early electrical literature and had accumulated a valuable library with many unique items. Unfortunately the late great fire visited his office and wiped the collection out of existence. Mr. Morrison naturally feels this loss very keenly and is, we fear, hardly likely to do his work all over again. Such losses are, indeed, irreparable.

NEW INDUSTRIAL COMPANIES.

THE ATLANTIC-PACIFIC STREET RAILWAY & SURETY COMPANY, Jersey City, N. J., has been incorporated with a capital stock of $200,000. The incorporators are R. R. Robinson, D. J. Huger and Michael J. McTiernan.

THE AUTOMATIC SAFETY STOP COMPANY OF AMERICA, New York, N. Y., has been incorporated with a capital stock of $500. The directors are G. L. Schiesser, G. G. Wacker and M. M. Ruttenau.

THE OLIVER ELECTRIC COMPANY, of Jersey City, N. J., has been incorporated with a capital stock of $1,000,000. The incorporators are Eben F. Oliver, Edwin R. Lampson, Rutherford Trowbridge, and Edwin Lampson.

THE SOUTH SIDE AUTO COMPANY, of St. Louis, Mo., has filed articles of incorporation, the capital stock being $5000. The incorporators are C. H. Michaelis, William R. Orthwein, Newman Samuels, Louis A. Hoerr and John Hoerr, Jr.

THE UNIVERSAL ELECTRIC EQUIPMENT COMPANY, Birmingham, Ala., has been incorporated with a capital stock of $100,000. The incorporators are J. E. Thompson, Charlestown, W. Va.; Daniel Rogan, G. G. Sharpe, A. W. Nelson, John L. Parker and E. J. Rogan, all of Birmingham.

OBITUARY.

MR. M. L. MORGAN, who had been connected with the Western Union Telegraph Company for over forty years, and was, until two years ago, manager of the local office, died at Albany, on September 16, at the age of sixty.

MR. N. S. POSSONS.—A man widely and favorably known in Cleveland and with a national standing in Masonry and electricity, died last week in that city. We refer to Mr. Nathan Sawyer Possons, president of the Equity Savings & Loan Company, and treasurer of the Park Realty Company. He had been ill for six months. Mr. Possons was born in Coeymans, N. Y., on September 27, 1844. He had a good academic education, early became greatly interested in mechanics, served an apprenticeship and had a subsequent experience in mechanical lines that eminently fitted him for the appointment as United States inspector of firearms, which position he held with credit for many years. He went to Cleveland in 1879 to take charge of the Telegraph Supply Company, which later became the Brush Electric Company. He remained as superintendent until October, 1890, when he accepted a like position with the Belding Motor Company, of Chicago. In 1891 he returned to Cleveland and organized the Universal Electric Company and was elected president and general manager. Mr. Possons was both a mechanical and an electrical engineer, and numerous machines were invented and patented by him. Mr. Possons was a thirty-second degree Mason, a Knight Templar, and a Shriner. He was a member of the Cleveland Chamber of Commerce and a member of the Colonial Club. For many years Mr. Possons had been a member of the Case Avenue Presbyterian Church, of which congregation he was an elder at the time of his death. He is survived by his widow, one brother and two sisters.

Trade Notes.

DOUBLEDAY-HILL ELECTRIC COMPANY, of Pittsburg, Pa., is issuing some interesting circulars and literature relative to its supply business, and is enjoying the natural reward of its originality and enterprise.

EMERSON ELECTRIC MFG. COMPANY, St. Louis, Mo., has just issued a new bulletin, No. 3059, devoted to its sewing machine motors, direct and alternating current. The motor and method of attachment are illustrated.

ELECTRO DYNAMIC COMPANY.—On and after September 26, all communications to the Electro Dynamic Company should be addressed to Avenue A and North Street, Bayonne, N. J., where the company has occupied a large new factory well equipped for the production of its electrical apparatus.

NERNST LAMPS.—The Nernst Lamp Company, Pittsburg, Pa., has just issued a neat little pamphlet on the subject of "The Nernst Lamp for Store Lighting." The advantage of the Nernst light in the matching of goods is strongly emphasized, and this, together with the greatly reduced cost of maintenance, are strong arguments that should win the favor of managers of trading establishments, especially department stores. The subject should receive the careful consideration of this class of business men.

SUBWAY CAR WIRING.—As the time approaches when the New York Subway trains will be put into operation, the public interest naturally increases, and it will be a great satisfaction to the people who expect to travel in them to know that every precaution has been taken to prevent the cars from catching fire. The electric light wires in the cars run through the Sprague Company's flexible metallic conduit, which is extensively used in the best and most modern buildings throughout the country. Flexible metallic conduit is a tube formed by a succession of steel convolutions which give not only great flexibility to the tube, but also, by its metal composition, a thorough protection to the insulated wires which it carries. Injury from rodents or mechanical causes is thus prevented and even a short circuit will produce no serious damage, so that safety to the passengers is insured and they have nothing to fear from defective wiring.

GAS AND GASOLINE ENGINES.—The development of gas and gasoline engines has been wonderfully rapid in the last few years, and these economical machines are found all over the world performing work as reliably and continuously as any other form of prime mover ever invented. The S. M. Jones Company, Toledo, Ohio, in its Acme gas and gasoline engines has a type of machine that is claimed to be unsurpassed in correct design and economy of operation. In its operation both gas and gasoline may be used at the same time. With gas it consumes 12 to 15 feet of natural gas per brake horse-power per hour, about 20 cu. ft. per brake horse-power per hour for artificial gas and with gasoline from ⅛ to 1-10 gallon per brake horse-power per hour, depending upon the size of the engine and other conditions. It is a plain type of four-cycle engine, and is available for application wherever power is required—in the mill, the shop, the mine, the farm, the field and the forest. The Acme engines are made in sizes varying from 10 to 50 horse-power. The Jones Company also manufactures the Rathburn gas engine, which is of the vertical multiple-cylinder type and designed principally for driving electric generators. It is carefully designed and embodies the best modern gas engine practice, besides possessing several new features. The company has recently established a new plant for the manufacture of its engines and is prepared to build machines in any size required, anywhere from 10 to 1000 horse-power. The consumption of artificial gas in the Rathburn engines is 18 cu. ft. per brake horse-power per hour, or 24 feet per kw-hour. With producer gas one brake horse-power should be obtained on one pound of good coal. The Jones Company issues two excellent catalogues describing and illustrating these two classes of engines.

Record of Electrical Patents.

UNITED STATES PATENTS ISSUED SEPT. 13, 1904.

[Conducted by Rosenbaum & Stockbridge, Patent Attys., 140 Nassau St., N. Y.]

769,698. ELECTRIC SWITCH; James C. Keller and Otto F. Kadow, Cleveland, Ohio. App. filed June 10, 1903. A ring-shaped electro-magnet open at one point and hinged at an opposite point, draws together when energized and by means of connections moves the switch tongue of a railway track.

769,700. MEANS FOR OPERATING SEWING OR OTHER MACHINES; Nathan Krawitzky, New York, N. Y. App. filed Jan. 9, 1904. Details of switch and brake mechanism by which an electrically driven sewing machine is controlled.

769,701. TWO-WIRE MULTIPLE TELEPHONE SYSTEM; Jacob W. Lattig, West Bethlehem, and Chas. Lane Goodrum, of Philadelphia, Pa. App. filed June 6, 1903.

769,702. TELEPHONE TRANSMITTER; Jacob W. Lattig, West Bethlehem, and Chas. Lane Goodrum, Philadelphia, Pa. App. filed June 6, 1903.

769,738. LIGHTNING ARRESTER; Willis H. Geist and John E. Geist, Gallatin, Mo. App. filed April 26, 1904. Details.

769,739. ELECTRIC LIGHTING DEVICE; Otto Gergacsevics, Vienna, Austria Hungary. App. filed Nov. 30, 1903. Details of a gas igniter.

769,751. MOTOR FOR PORTABLE TOOLS; Peter La Court, Clinton, Mass. App. filed Oct. 23, 1901. The field magnet of the motor is shaped to form a handle by means of which the motor and the tool on its shaft can be be held in the hand and manipulated.

769,760. TELEPHONE EXCHANGE SWITCHBOARD APPARATUS; Frank B. McBerty, Evanston, Ill. App. filed Jan. 13, 1902.

769,761. RELAY; Frank B. McBerty, Evanston, Ill. App. filed Dec. 15, 1902.

769,763. APPARATUS FOR THROUGH RINGING ON TELEPHONE TRUNK LINES; Jas. L. McQuarrie, Chicago, Ill. App. filed Dec. 14, 1901.

769,792. FEED-WATER PURIFIER AND FILTER; William Dougherty, Chester, Pa. App. filed Oct. 17, 1903.

769,812. SYSTEM OF MULTIPLE ELECTRIC MOTOR CONTROL; William Baxter, Jr., Jersey City, N. J. App. filed Aug. 20, 1903. (See Current News and Notes.)

769,813. SYSTEM OF SIGNALING ON RAILWAYS; Francois Bongrand, Cusset, France. App. filed Aug. 7, 1900. Details.

769,815. DYNAMO; Martin C. Burt, Chicago, Ill. App. filed Nov. 14, 1903. An armature is ventilated by constructing it with inter-spaces between the plates of its core, the plates being perforated and a fan being located at one end to drive air through the various orifices.

769,824. ELECTRIC FIRE ALARM; William B. Hopkinson, Muscatine, Iowa. App. filed April 15, 1904. A melting fuse ignites an explosive which drives a circuit closer into engagement with a pair of terminals where it is held to give a continuous alarm.

769,842. ELECTRIC ARC LAMP; Frederik Sindingchristeensen, New York, N. Y. App. filed Sept. 29, 1903. A pair of armatures are situated and movable within the cavity of a solenoid, a pair of angularly disposed carbons being carried by the armatures.

769,854. TROLLEY WHEEL; William T. Wilkinson, Medford, Mass. App. filed Dec. 18, 1903. A tread portion in which the entire groove for the wire is formed, is confined between two side cheeks.

769,862. GUARD FOR THIRD RAILS; John H. Guest, Brooklyn, N. Y. App. filed Dec. 12, 1903. A non-conducting strip rests upon the third rail and is lifted by the shoe as it passes along.

769,863. TELEPHONE ATTACHMENT; William Stanley Haddock, Uniontown, Pa. App. filed Aug. 20, 1903.

769,916. TELEMOTOR FOR STEERING SHIPS OR OTHER USES; Mathias Pfatischer, Philadelphia, Pa. App. filed Dec. 21, 1900. The system includes a generator which can be started by power in either direction at will, a motor actuating the rudder and supplied by the generator and connections whereby the generator can be stopped by the motor after it has moved the rudder to the proper position.

769,934. APPARATUS FOR DIRECTLY OPERATING RAILWAY SWITCHES AND SIGNALS BY MEANS OF A SINGLE LEVER; Gustave Bleynie and Theophile Ducousso, Paris, France. App. filed Oct. 26, 1903. Details.

769,961. CIRCUIT PROTECTING DEVICE; Edwin W. Rice, Jr., Schenectady, N. Y. App. filed Feb. 18, 1903. A number of spark gap terminals and a single body of high resistance material having a series of points in the length thereof electrically connected respectively to the terminals.

769,975. STORAGE BATTERY; Jas. P. Wood, Buffalo, N. Y. App. filed March 14, 1904.

769,983. BLOCK SIGNAL SYSTEM; Fred B. Corey, Schenectady, N. Y. App. filed Feb. 10, 1904. (See Current News and Notes.)

769,984. ELECTRICAL MEASURING INSTRUMENT; Thomas Duncan, Chicago, Ill. App. filed June 26, 1901. A phase difference indicator comprising a current field-winding producing magnetism that varies in phase with the magnetism of the current in the working circuit and two pressure windings which co-act with the current windings to cause the movement of a needle to indicate the extent the current may lag or lead with respect to the pressure.

769,985. ELECTRICAL MEASURING INSTRUMENT; Thomas Duncan, Chicago, Ill. App. filed June 26, 1901. An instrument for indicating the lag and lead of the current having pressure windings producing fields out of phase, a current winding, means whereby the latter may produce a field varying in phase with the phase of the current of the system and differing in phase from both pressure windings, and automatic devices associated with the windings whereby the magnetization due to the windings is held constant.

769,986. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 18, 1901. The normal torque of the meter is varied to provide for several rates by using supplemental windings and supplemental circuits.

769,987. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 18, 1901.

769,988. ELECTRIC METER; Thomas Duncan, Chicago, Ill. App. filed July 18, 1901.

769,989. ELECTRICAL MEASURING INSTRUMENT; Thomas Duncan, Chicago, Ill. App. filed Aug. 26, 1901.

770,040. MOTOR CONTROL SYSTEM; Charles E. Barry, Schenectady, N. Y. App. filed April 18, 1903. The contact operating devices are controlled by a number of relays, automatically and successively, the relays being adjusted to respond to certain successive increments of counter-electromotive force in the motor circuit as the motor increases in speed.

770,041. ELECTRIC RAILWAY; Asa F. Batchelder, Schenectady, N. Y. App. filed March 29, 1901. (See Current News and Notes.)

770,054. ELECTRICAL CONNECTOR; Philip Fielding, New York, N. Y. App. filed July 31, 1903. Male and female members, one of which has a central web carrying offset contact pieces, and the other two tongues adapted to straddle the web and carrying contacts corresponding with those in the first member.

770,073. METHOD OF CONTROLLING ELECTRIC MOTORS; Charles W. Kennedy, Rutledge, and Francis A. Pocock, Landsdowne, Pa. App. filed April 16, 1902. A system for operating two or more motors without external resistance, the motors having two sets of armature windings and being started as series machines, then speeding up by variations of the connections of the field magnets and armature winding and then running at full speed as shut machines.

770,091. ALTERNATING-CURRENT MACHINERY; Addams S. McAllister, Ithaca, N. Y. App. filed Feb. 15, 1904.

770,092. ALTERNATING-CURRENT MACHINERY; Addams Stratton McAllister, Ithaca, N. Y. App. filed March 23, 1904.

770,098. DYNAMO REGULATOR; Geo. S. Neeley, St. Louis, Mo. App. filed Jan. 19, 1904. The regulator comprises a pair of arc-forming contacts in series with the exciter field winding and a solenoid in circuit with the alternating generator and adapted to regulate the resistance of the exciter field winding.

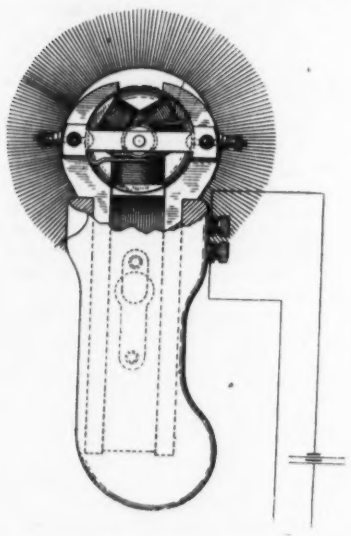
770,099. VOLTAGE REGULATOR FOR DYNAMOS; George S. Neeley, St. Louis, Mo. App. filed April 1, 1904. The invention relates to the particular construction of two solenoids having mechanically connected cores and means for adjusting the same.

770,109. VAPOR ELECTRIC APPARATUS; Max Von Recklinghausen, New York, N. Y. App. filed Oct. 17, 1903.

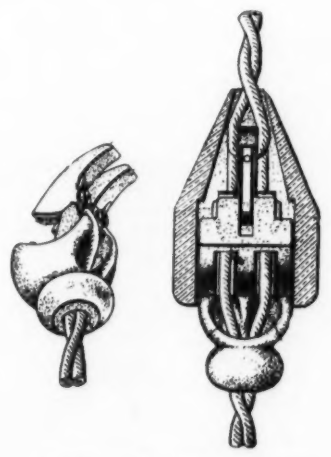
770,113. TROLLEY HARP; Edward D. Rockwell, Bristol, Conn. App. filed Jan. 13, 1904. Details affording a swivelling movement to the wheel.

770,133. PLATE FOR STATIC MACHINES; Henry E. Waite and Harry F. Waite, New York, N. Y. App. filed Dec. 11, 1903. The plate is provided with a radial rib which produces an agitation or circulation of air around and between the plates, tending to keep them dry.

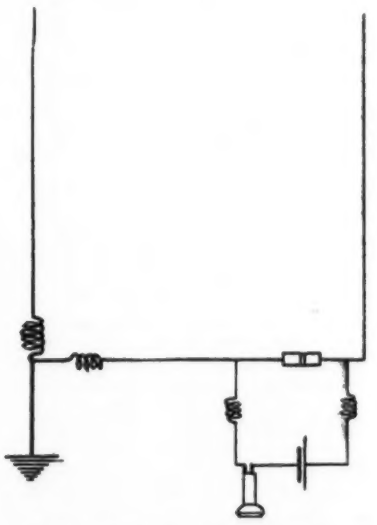
770,140. ELECTRODE FOR BATTERIES; Albert C. Wood and Jas. A. McMullan, Philadelphia, Pa. App. filed April 22, 1902.



769,751.—Motor for Portable Tools.



770,054.—Electrical Connector.



770,229.—Wireless Signaling Apparatus.

769,991. SYSTEM OF ELECTRICAL DISTRIBUTION; Wm. L. R. Emmet, Schenectady, N. Y. App. filed Feb. 9, 1900. In a switch for cutting out the sections of a secondary winding provided with means for snapping the points of connection of the main circuit from one tap to another in such a manner that the arc formed in passing out of engagement with one contact is not interrupted until engagement is made with the next, thus preserving the continuity of the current while the circuit changing operation is taking place.

769,993. COLLECTOR RING AND MEANS FOR SECURING IT INTO POSITION; Hermann F. T. Erben, Schenectady, N. Y. App. filed Jan. 15, 1903. The rings are placed around a cylindrical support and connected therewith by spokes which are staggered with respect to the spokes in adjoining rings so that a lead attached to a spoke may be carried out without interference with the spoke of other rings.

769,995. CUT-OFF OR FUSE FOR ELECTRIC CIRCUITS; Otto Feuerlein, Charlottenburg, Germany. App. filed Sept. 9, 1899.

769,996. ELECTRIC ARC LAMP; Richard Fleming, Lynn, Mass. App. filed Feb. 20, 1903. To prevent vibration from loosening the clutch, this invention provides that a slight amount of slipping shall result in the clutch engaging the electrode with a grip much greater than the normal.

770,007. TIME LIMIT CIRCUIT BREAKER; Edward M. Hewlett, Schenectady, N. Y. App. filed Feb. 11, 1899. Details of a time limit device for automatic circuit breakers.

770,014. ELECTROMEDICAL APPLIANCE; Samuel H. Linn, Rochester, N. Y. App. filed April 14, 1904.

770,017. AUTOMATIC REGULATOR; Walter S. Moody, Schenectady, N. Y. App. filed Jan. 9, 1903, In an electric system, a voltage-changer, a motor generator, a device responsive to the condition of said system, and means controlled thereby for establishing an operative connection between said changer and the motor-generator.

770,028. BRAKE FOR ELECTRIC MOTORS; Leonard A. Tirrill, Lynn, Mass. App. filed Feb. 16, 1904. The short circuit into which the motor armature is thrown, contains a brake magnet which acts upon the rotary part driven by the motor and thus relieves the excessive strain on the belt which ordinarily takes place when the armature is thrown onto a dead short circuit.

770,033. ELECTROLYTIC METER; Howard I. Wood, Schenectady, N. Y. App. filed Feb. 14, 1903.

770,034. FUSE; Gilbert Wright, Pittsfield, Mass. App. filed Sept, 28, 1903. The end of the fuse projects through the end of the tube in which it is supported and is wrapped around the conical exterior thereof and there clamped by a cap.

770,148. ELECTROPLATING MACHINE; James Bailey, Walsall, England. App. filed Feb. 14, 1903. A continuous chain conveyor serving as a cathode is arranged in parallel lengths and supported by a framework, with anodes standing between the lengths of the conveyor.

770,157. TELEPHONE DESK STANDARD; Chas. L. Boyce, Detroit, Mich. App. filed Aug. 9, 1902.

770,158. THIRD RAIL COVERING; Thomas Buckley, New York, N .Y. App. filed April 28, 1904. A roof over the third rail made in two parts which are hinged to open and close as the shoe passes.

770,166. ELECTRICAL SWITCH; Harry W. Cox, Nottingham, England. App. filed July 15, 1903. Details.

770,175. BRUSH AND BRUSH-HOLDER FOR MAGNETO-ELECTRIC MACHINES; Edward B. Jacobson, Pittsfield, Mass. App. filed Aug. 20, 1903. The brush has a core of wire gauze wound in spiral form and surrounded by a cylindrical body of graphite, all contained in a tube.

770,184. ATTACHMENT FOR TELEGRAPH SOUNDERS; John F. Mickey, Baltimore, Md. App. filed May 2, 1904. Details.

770,194. TENSIONAL LOCK FOR ADJUSTING SCREWS; Charles F. Splitdorf, New York, N. Y. App. filed Nov. 18, 1903. The adjusting screw of an induction coil vibrator is prevented from working out of adjustment by a spring interposed between the head of the screw and the frame through which the screw works.

770,197. GAS OR VAPOR ELECTRIC DEVICE; Percy H. Thomas, Pittsburg, Pa. App. filed May 2, 1903.

770,198. METHOD OF REPLENISHING ELECTRIC WASTE IN GAS OR VAPOR ELECTRIC DEVICES; Percy H. Thomas, Pittsburg, Pa. App. filed May 2, 1903.

770,223. INCANDESCENT LAMP BULB; Francis M. F. Cazin, Hoboken, N. J. App. filed March 17, 1904. (See Current News and Notes.)

770,228. RECEIVER FOR SPACE SIGNALING; Lee De Forest, New York, N. Y. App. filed Dec. 24, 1902. The two poles are bridged by a rod held delicately in under-contact therewith by a spring.

770,229. WIRELESS SIGNALING APPARATUS; Lee De Forest, New York, N. Y. App. filed March 14, 1903. Disturbing effects are prevented in the wave-responsive device by means of a tuned and an untuned wave-collecting system oppositely connected therewith.

770,232. GAS OR VAPOR ELECTRIC LAMP; Peter Cooper Hewitt, New York, N. Y. App. filed Feb. 12, 1902.

770,233. GAS OR VAPOR ELECTRIC APPARATUS; Peter Cooper Hewitt, New York, N. Y. App. filed Feb. 12, 1902.

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FOR CARD INDEX
ELECTRICAL WORLD AND ENGINEER, SEPT. 17, 1904

Foreign Electrical Jurors at St. Louis	454
Sustaining Tesla Patent on Appeal	454
New York State Street Railway Convention	454
The Northern California Power Company's Systems—II	455
Design of Armature Coils	461
German Electrical Exhibits at the World's Fair—III. By Franz Welz	462
Novel Power Scheme for Colorado	464
Note on Shawinigan Power	464
Fifth International Electrical Congress, St. Louis	465
The Tour of the Foreign Engineers and Electrical Congress	477
Lighting in St. Louis City. By Walter I. Barnes	482
Wireless and the Truth. By Baldwin Stevens	482
Digest of Current Electrical Literature	483
Motors in a Bread Bakery. By H. W. Heinz	486
A New Three-Phase Static Ground Detector	486
The Westinghouse Turbine Exhibit at St. Louis	487
Ingenious Motor Application to a Planer	489
Steam Turbine Condenser Outfits	489
Storage Battery Locomotives at St. Louis	490
Pothead Bracket for Telephone Cables	490
Engine Type Generator	490
Electrical Exhibits at the Minnesota State Fair	491

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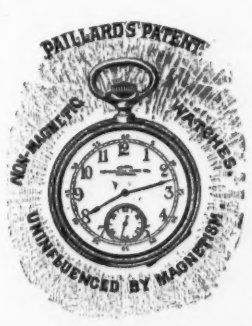

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POSITION WANTED.—As manager or superintendent of central station or light and water works, by technical man; ten years' experience; interior wiring, central station construction, operation, management; close buyer; economical operator; good solicitor; associate member A. I. E. E.; age 34; excellent habits; energetic; married; good reference. Address No. 1621, care Electrical World and Engineer, New York.

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POSITION WANTED.—By electrician in power house, mine mill, factory, etc.; my experience covers all kinds of wiring, such as motors, cars, lights (arc and glow) telephones, etc., also their operation, care, etc.; mechanical training. Address No. 1657, care Electrical World and Engineer, New York.

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WANTED.—Good mechanical draughtsman; must be perfectly familiar with telephone work. Address No. 1646, care Electrical World and Engineer, New York.

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WANTED.—Electrical engineer. One thoroughly versed in contracting, competent to manage a contracting department and financially able to invest at least $5,000 in a business of unquestioned merit and future; give experience, present connection and at least three references; if satisfactory appointment for interview will be made; unless qualified as above no attention will be paid to communication. Address J. P. Staats, P. O. Box 2107, New York City.

WANTED.—Superintendent for an electrical cable mill who is technically educated and has had practical experience; must be a high-grade man; all communications strictly confidential. Address No. 1649, care Electrical World and Engineer, New York.

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WANTED.—A mechanical engineer, experienced in traveling crane work who has unquestioned ability to take entire charge of drawing room and the management of the work and men in that department; one who has held similar position will be given preference; to the right party a splendid opportunity is offered. Address No. 1647, care Electrical World and Engineer, New York.

WANTED.—Salesman for incandescent lamps. State age, height and weight, whether married or not, electrical experience, whether college graduate; what degree, and territory familiar with. Address No. 1446, care Electrical World and Engineer, New York.

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Lt.		
1	300	Westinghouse, 15-K.W.
1	500	Wood, 25-K.W.
1	900	West., 45-K.W., 2 phase.
2	1200	West, 60-K.W.
1	1500	Warren-Medberry, 75-K.W.
1	1500	Westinghouse, 75-K.W.
1	1500	Westinghouse, 75-K.W., 2 ph. d. c. to 14x14 Gates 4-valve aut. engine.
1	1500	Westinghouse, 75-K.W., 2-phase, belted.
1	1800	Gen. Elec., 90-K.W.
1	2400	Gen. Elec., 120-K.W., 3 ph.
2	3000	Warren, 150-K.W.
1	7200	Gen. Elec., 360-K.W., 3 ph.

ALTERNATORS—125-133 CYCLES.

Lt.		
1	350	T.-H. A. 18.
1	650	Wood, 33-K.W.
1	750	West., 37½-K.W.
1	750	Wood, 37½-K.W.
1	1000	Wood, 50-K.W.
2	1200	Gen. Elec., 60-K.W.
1	1200	Westinghouse, 60-K.W.
1	2400	Gen. Elec., 120-K.W., A. 120.
2	2400	Gen. Elec., 120-K.W., A.S.120.
2	3000	Stanley inductor, 150-K.W.
1	4000	Westinghouse, 240-K.W.

110 TO 125 VOLT GENERATORS (COMPOUND).

DIRECT CURRENT.

Lt.		
1	40	Roth, M.P., direct connected to Drake engine.
1	40	Wood, Multipolar.
3	45	Westinghouse, Multipolar.
1	50	Crocker-Wheeler.
1	50	Northern, Multipolar.
1	50	Gen. Elec.
1	75	Phoenix, direct connected to Case engine.
1	80	Card, Multipolar.
2	110	Commercial, Multipolar.
1	150	Card, Multipolar.
1	150	Western Elec., Multipolar.
1	150	General Electric, Multipolar.
1	165	Am. Engine Co., Multipolar.
1	210	Edison.
1	210	Phoenix, Multipolar.
1	210	Eddy, Multipolar.
1	225	Card, Multipolar.
1	260	Commercial, Multipolar.
1	340	Perritt, Multipolar.
1	300	Ahlms-Edwards, Multipolar.
2	350	Edison, 20-K.W.
2	350	C. & C., Multipolar.
1	400	Northern, Multipolar.
1	400	Crocker-Wheeler, Multipolar.
2	400	Westinghouse, Multipolar.
2	450	Commercial, Multipolar.
1	450	Quaker City, Multipolar.
1	450	Triumph, Multipolar.
2	450	Sprague-Lundell, Multipolar.
1	450	Eddy, Multipolar.
1	450	Gen. Electric, Multipolar.
1	450	Western Elec., Multipolar.
2	540	Edison, 30-K.W.
1	540	C. & C., 30-K.W., Multipolar.
1	540	Elwell-Parker, Multipolar.
2	540	Gen. Elec., Multipolar.
3	600	Card, Multipolar.
1	650	Milwaukee, Multipolar.
1	650	Westinghouse, Multipolar.
1	650	Churchward, Multipolar.
1	650	Westinghouse, Multipolar, 35-K.W., engine type, direct connected to 10x10 enclosed self-oiling Buffalo Forge engine.
2	700	Commercial, Multipolar.
2	800	Gen. Elec., Multipolar.
2	800	Crocker-Wheeler, Multipolar.
1	900	Wagner, Multipolar, comp.
1	1000	Edison, 60-K.W.
1	1000	Gen. Elec., 6 pole, comp., direct connected to 12x13 Weston automatic engine, 60-K.W.
1	1100	Triumph, Multipolar.
1	1300	Card, Multipolar.
2	1300	Gen. Elec., M.P., 65-K.W.
1	1350	Fort Wayne, comp., direct connected to 13x14 Buckeye vertical engine, 80-K.W.
2	1350	Gen. Elec., Multipolar, 6 pole shunt, direct connected to Ames tandem comp., 11x17x12 automatic engine.
2	1500	Gen. Elec., M.P., 85-K.W.
2	1800	Edison, 100-K.W.
1	1800	Western Electric, Multipolar, comp., 6 pole, 100-K.W.
2	2500	Western Electric, Multipolar, comp., 150-K.W., direct connected to 16x18 McEwen engine.

220 TO 250 VOLT COMPOUND GENERATORS.

K.W.		
1	7½	Holtzer-Cabot.
1	9	New England, Multipolar.
2	10	T.-H.
1	12	Milwaukee, Multipolar.
1	17½	Kester.
1	17½	Eddy.
1	20	Western Electric.
1	20	Eddy, Multipolar.
3	20	Western Elec., Multipolar.
1	30	Gen. Elec., Multipolar.
1	40	E. & C., Multipolar.
1	40	Eddy, Multipolar.
1	45	Edison.
2	45	Am. Engine Co., Multipolar.
1	45	Western Elec., Multipolar.
1	45	C. & C., Multipolar.
1	45	Gen. Elec., Multipolar.
1	50	C. & C.
1	50	Commercial, Multipolar.
1	50	Maine, Multipolar.
1	55	Fuller, Multipolar.
1	75	Siemens & Halske, Churchward type, Multipolar, for direct connection.
1	80	C. & C.
1	100	Commercial, Multipolar.
1	125	Eddy, Multipolar.
2	150	National, Multipolar.
1	200	Eddy, Multipolar.
1	200	Westinghouse, Multipolar.
1	300	Western Elec., Multipolar.

500 TO 550 VOLT COMPOUND GENERATORS.

K.W.		
1	60	Edison.
1	62	T.-H.
1	75	Akron, 6 pole.
1	75	General Electric, Multipolar.
1	100	Siemens & Halske, Multipolar.
2	100	Edison.
1	100	Gen. Electric, Multipolar.
1	110	Gen. Electric, M.P., 6 pole.
1	120	Westinghouse.
1	200	Thompson-Ryan.
1	200	General Electric, Multipolar.

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Costs Money

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the handy, non-corrosive flux that makes the solder flow and insures good joints for electrical work. We'll send you a generous sample

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These Turbines are recognized as the most effective Water Wheels made.

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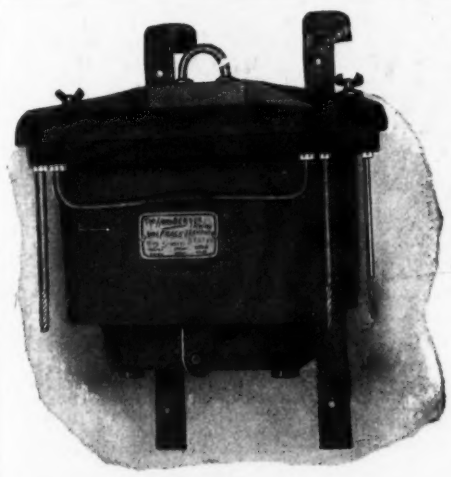

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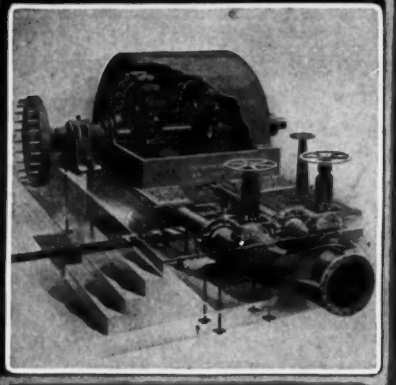

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From the island of Java last month came five different orders for Pelton Water Wheels.

These wheels will be used in connection with the development of power for quarries, coffee, tea and other industries.

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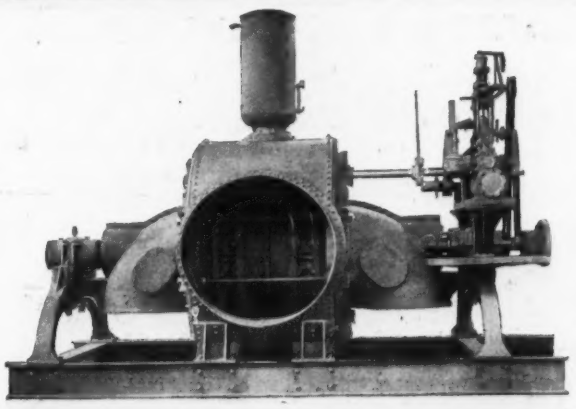

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The QUICKER the SPEED of a GENERATOR the LOWER its COST. The SAMSON has a quicker speed for a given power than any other turbine built. If you expect to DIRECT CONNECT generator to turbine shaft we can certainly SAVE you considerable EXPENSE in your installation.

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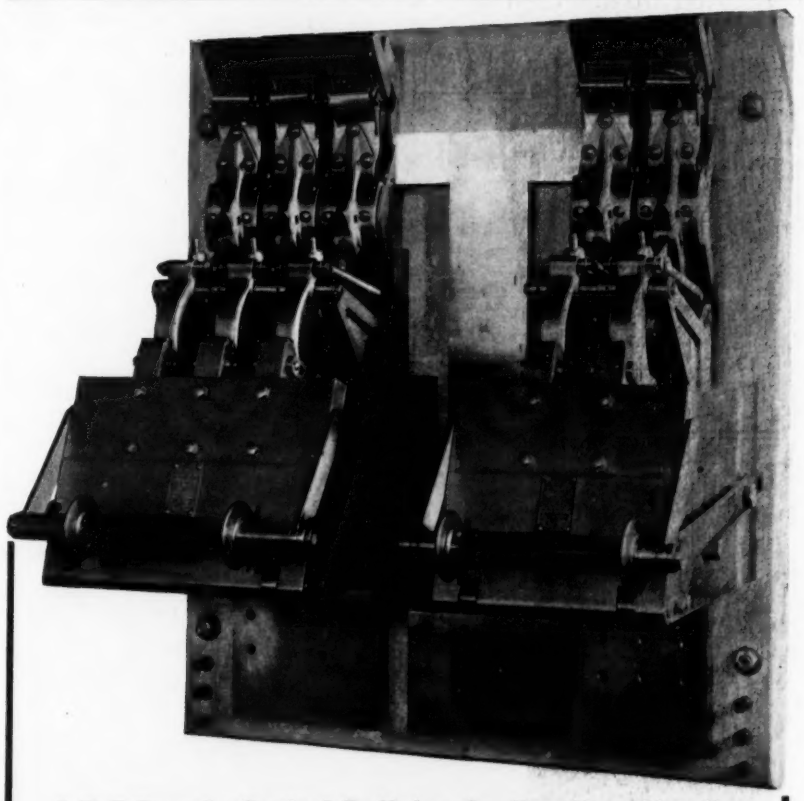

I-T-E Remote Control Switches for Equalizer Circuits

Where equalizer leads are run from the generator to the switchboard and back through a considerable distance, not only are the series field circuits given unduly high resistance, but in addition to this the cost of the copper cables becomes excessive. While these conditions render obvious the desirability of having the equalizer switches located close to the generators, at the same time it is also evident that these switches must be under the immediate control of the switchboard attendant.

We illustrate herewith a pair of equalizer switches which we have designed and developed to meet these conditions. The right-hand switch is of 2000 amperes, the left-hand of 3000 amperes capacity. The upper terminal of each connects with the equalizer main, which takes the place of the equalizer bus otherwise required at the switchboard.

The closing and opening of the switches is effected from the switchboard by the movement of a small double throw switch.

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